Recent Progress in the Public Supply of Hydraulic Power.*

BY MR. E. B. ELLINGTON.

(*Concluded from page 309.*)

Relative Economy of Hydraulic Power.—The most important point to the public and to the company in connection with the supply of hydraulic power on the system we are discussing is, after all, not the means adopted to produce and convey the power, however interesting and instructive may be the study of these methods to us as engineers, but whether the power can be economically and profitably applied to the various purposes for which power is required, and I propose to conclude my remarks by giving you some particulars of the uses for which the power has already been adopted. They will, I think, conclusively show that in many important operations connected with the business of a great city, hydraulic power is unsurpassed for simplicity, convenience and economy. The following is the scale of charges adopted in London:

A minimum charge is made for each machine of 1*l.* 5*s.* per quarter.

The quantity of power used is registered by taking the number of gallons passing through the machine on the consumer's premises, and is supplied on a sliding scale as follows:

Gallons.			Per Quarter. £. s.	
Under 3,000			1 5	per machine.
Above 3,000	not exceeding	5,000	0 8	per 1,000 gals.
" 5,000	"	10,000	0 7	"
" 10,000	"	20,000	0 6	"
" 20,000	"	50,000	0 5	"
" 50,000	"	100,000	0 4	"
" 100,000	"	200,000	0 3	"
" 200,000 by special terms (2*s.* 6*d.* to 1*s.*)				

The charge under a lower rate is not in any case less than the maximum charge at the next highest rate. Accounts are made up quarterly.

The meter rent is about 5*s.* per quarter per machine, including maintenance of meter.

It will be seen that the minimum charge, including meter rent, for working any machine, is only 6*l.* per annum.

For this sum four or five tons of goods can be raised 50 feet or 10 tons 25 feet on the average every working day of the year.

If the consumer has a large place, several machines and a large trade, owing to the sliding scale, 12 to 15 tons can be raised 50 feet or 30 tons 25 feet, every working day throughout the year for the same money, and in certain cases even more than this can be done.

Now this is a very low rate and represents only a maximum charge of about 1¼*d.* to a minimum of ¼*d.* per 50 foot-tons of actual useful work accomplished in weight of goods raised.

Expressing the cost of the power in this way is, however, by no means to state the whole advantage for lifting apparatus when compared with other systems, for this reason—the cost of the hydraulic power is almost the only expense of working, whereas with all other systems the total cost is a very much larger sum than is represented, say, by the cost of the gas in the gas engine, or the cost of fuel in a steam engine.

I had put into my hands the other day a statement which I find emanated from the American Elevator Company, a company now seeking to introduce into this country a system of passenger lifts, which I believe would never have found favor in the United States in its present form had high-pressure hydraulic apparatus been better known there. This statement was supposed to be a careful and reliable examination into the relative cost of different systems of power for working passenger lifts. It was as follows:[1]

"REPORT ON WORKING HYDRAULIC LIFTS.

" . . . . a comparison of the cost of performing a given amount of elevator service by means of power furnished in various ways.

"For the purpose of making this comparison, suppose the following case to be dealt with, *viz.*, two elevators or lifts are to be fixed in an office building, each of which must travel 80 feet vertically—must carry a load of 18 passenger, must accomplish 20 complete journeys or trips per hour, and must work 10 hours per day that is to say, 7200 passengers could be carried 80 feet high per day, and 7200 passengers could be lowered per day, or in other words, 14,400 passengers to be handled in one day.

"If we were called to deal with this case we would place a tank at the top of the building, giving, I assume, 100 feet head, to which water would be pumped from a tank in the basement. The hydrostatic pressure due to 100 feet head would therefore be the power. The elevators would exhaust the water into the basement tank, and the pumps would pump it back again to the top tank, thus using the same water over and over again. Therefore the cost of working the two elevators would be the cost of pumping the required quantity of water 100 feet high. Two elevators doing the said amount of work by our system would make it necessary to pump 200 gallons of water per minute 100 feet high = 7.3 horse-power. This to be done 10 hours = 1 day.

"Now compare various ways of doing the required pumping of 200 gallons per minute, 100 feet high 10 hours per day.

"1st. Operate the pump by a six horse-power gas engine. Then using 20 feet of gas per indicated horse-power per hour, the consumption would be 2314 feet at 3*s.* = 6*s.* 11*d.*

"2nd. Use a Worthington steam pump which would require 876 lb. coal at 18*s.* per ton = 7*s.*; or a compound pump 584 lb. coal at 18*s.* per ton = 4*s.* 8*d.*

"3rd. Instead of using either steam or gas engine, work the pump by the hydraulic pressure laid on by the Hydraulic Power Company, then pump 8½ inch plunger, 10 inch stroke, speed, 80 feet per minute; area of plunger, 56.75 inch, hydraulic pressure; 43.5 lb. per square inch. Total hydraulic pressure say 2468, one-third frictional loss, say 822 = 3290 lb.

"Taking Power Company's pressure at 700 lb. per square inch, this would require piston area of 4.7 inch, and this doing the above duty would use 9764 gallons per day at 2*s.* 6*d.* = 1*l.* 4*s.* 5*d.*

"Suppose you use patent balance ram lifts so perfectly balanced that you lift only the load + frictional allowance of 33½ per cent., then

	lb.
Required power is	4050
For frictional loss of 33½ per cent. is	1350
Making required load of eighteen passengers	2700

"Pressure being 700 lb. required area of ram is 5.8 inch = diameter 2¾ inch, but we suppose a ram not smaller than 3 inch would be used for 80 feet rise.

Then, 3 inch ram = area 7.07 inch × length 960 inches =6787.2 cubic inch = 24.47 gallons × 200 trips per day = 4894 gallons × 2 lifts = 9788 gallons at 2*s.* 6*d.* per 1000 gallons= 1*l.* 4*s.* 6*d.*[2]

"Suppose we adapt standard hydraulic elevator to take power direct from Power Company. The load = 2700 lb., gear 4 to 1, frictional loss of 50 per cent.

"2700 × 4 = 10,800 + 5400 = 16,200 lb. power required.

"Power Company's pressure of 700 lb. requires piston area of 23.14 inch. Therefore required 5¼ inch cylinders gallons per trip, 20.566 × 400 trips per day = 8226.4 gallons at 2*s.* 6*d.* = 1*l.* 0*s.* 7*d.*

A statement of this sort is really very misleading. On pointing this out to Mr. Gibson, the president of the American company, he informed me that the report was accompanied by a statement that of course the comparison excluded the element of superintendence which he estimated at 5*s.* per day. Now I make the relative cost, under ordinary circumstances, in the case assumed by the American Company, on the basis of equal efficiency in the lift, as follows:

I. *Work Done.*—Taking the particulars given in the report, 200 gallons required to be pumped 100 feet per minute = 200,000 foot pounds of useful work, or 6 horse-power, not 7.3 as stated.[1] This actual effective horse-power makes no allowance for friction in pipes or loss in the driving apparatus or pumps.

Eighteen passengers are taken as being equal to 2,700 pounds.

Work done for each complete journey, 300 gallons 100 feet = 300,000 foot-pounds of work; 2,700 pounds raised 80 feet high = 216,000 foot-pounds of work. The efficiency of the assumed lifts, is, therefore, say 70 per cent.

II. *Cost of Pumping.*—1. The gas engine proposed is 6 horse-power, but this is wanted in water pumped, and allowing for loss in pumps, driving gear, and pipes, 9 brake horse-power must be provided; 20 feet of gas being the amount used per indicated horse-power, 30 feet at least will be used for brake horse-power, 9 × 30 × 10 = 2,700 cubic feet at 3*s.* = 8*s.* 1*d.* cost of gas per day. This is, however, but a small portion of the total cost. Take the cost over twelve months:

5 complete days per week × 52 =	260
1 half-day per week × 52	26
	286
Less four Bank holidays, Good Friday and Christmas Day	6
Full working days	280

Then	£	s.	d.
Gas bill, say	113	0	0
Oil and waste used on gas engine and driving gear	15	0	0
Water to make up waste, etc	5	0	0
Value of space occupied by machinery, 20 feet by 10 feet × 2*s.*	20	0	0
Wages of mechanic in attendance, 30*s.* per week	78	0	0
Wear and tear, and depreciation and interest on engines, pumps, tanks, and pipes, foundations, and other structure work for same, say 600*l.* at 15 per cent[3]	90	0	0
	321	0	0

Divide by 280 working days = 1*l.* 3*s.* per day.

If duplicate pumping plant is provided the items for rent and depreciation will be increased by say 10*l.* and 40*l.* respectively, raising the cost to 1*l.* 6*s.* 6*d.* per working day.

2. *Using Steam Power.*—I will take the coal bill at the moderate estimate of two tons of coal, etc., per week, say:

	£	s.	d.
100 tons per annum, at 18*s.*	90	0	0
Waste oil, etc., used	15	0	0
Water used	10	0	0
Value of space occupied by engine, boiler, and coals, 20 ft. by 10 ft., at 2*s.*	20	0	0
Wages of Mechanic, at 30*s.* per week	78	0	0
Wear and tear, depreciation and interest on boilers, pumps, tanks, and foundations and structural work, 600*l.* at 15 per cent.	90	0	0
Extra outlay in inclosing boilers in fireproof building, 200*l.* at 7½ per cent. (If this is not done, charge for extra fire insurance).	15	0	0
	318	0	0

Divide by 280 working days = 1*l.* 2*s.* 9*d.* per day.

If duplicate pumping plant is provided as before, 1*l.* 6*s.* 3*d.* per day.

3. *Using Hydraulic Power to Pump.*—(This is a method which can only be considered advisable in place of altering existing low-pressure machinery, and is not an economical way of using the power for working lifts.)

A good hydraulic pump will work with 80 per cent. of efficiency.

Work required 200 gallons 100 feet per minute = 200,000 foot-pounds or 250,000 lb. at 80 per cent. efficiency, divided by 1,600 foot head, or 700 pound pressure water = 9,360 gallons per day of ten hours for 280 days per year.

	£	s.	d.
Annual charge for power (500,000 gallons and upwards per quarter are charged at 2*s.* per 1,000 gallons)	262	0	0
Oil, etc., used	5	0	0
Space occupied, 10 ft. by 10 ft., at, 2*s.*	10	0	0
Wages of superintendent	15	0	0
Wear and tear, depreciation on pump, tank, pipes, and foundattons, 300*l.* at 10 per cent.[4]	30	0	0
	322	0	0

Divide by 280 working days = 1*l.* 3*s.* per day.

If duplicate plant is provided the cost will be increased to 1*l.* 4*s.* 4*d.* per day.

4. *Using Patent Hydraulic Balance Lift*, giving the same efficiency as the lifts first considered, or 70 per

	£	s.	d.
Annual charge	210	0	0
Oil, etc., for machinery outside lift	0	0	0
Space occupied " "	0	0	0
Wages and superintendence	0	0	0
Wear and tear and depreciation on 20*l.* (cost of service pipe)	2	0	0
	212	0	0

Divide by 280 working day, 15*s* 2*d* per day.

Duplicate supply provided by company by laying on a second service raises the cost at 15*s* 4*d* per day.

5. *Using Standard or other Multiplying Rope of Chain Lifts with Hydraulic Power direct Pressure*, also giving 70 per cent. efficiency, same cost of power as above, viz., 15*s* 2*d* and 15*s* 4*d* per day.

I have assumed in all cases that the efficiency of the lifts is the same, the difference between properly balanced lifts of different construction is not due to theoretical efficiency but to practical manufacture and good design, and the special type to be selected is more generally a question of safety and convenience than of relative economy.

Summary.

	£	s.	d.
A. Hydraulic power supply directly applied[5] per average day	0	15	4
B. Hydraulic power supply through pumps and tanks per average day	1	4	6
C. Steam pumping plant	1	6	3
D. Gas pumping plant	1	6	6

Even this is an unfair comparison for the hydraulic power, for the particular case contemplated is one of which there is, I believe, no instance in London.

There is hardly a single office passenger lift which makes 200 journeys a day to a height of 80 feet.

An extreme case is that of two lifts travelling an average height of 50 feet, making 200 journeys per day of ten hours, and if such lifts are taken instead of the altogether outside case on which the former calculations are based the comparison is still more in favor of the public hydraulic power as it would be also in the case of a West-end lift, working eighteen hours a day, double shifts of men having to be employed.

Taking an average height of 50 feet per journey instead of 80 feet, all other particulars being the same, the comparison of the various systems is as follows.

	£	s.	d.
A. Hydraulic power supply used direct, per average working day	12	0	
B. Hydraulic power supply used indirectly, per average working day	20	3	
C. Steam engines and pump, per average working day	23	6	
D.—Gas engines and pump, per average working day	23	0	

* Paper read before the Liverpool Engineering Society.

[1] I have been led to refer fully to this statement, not ou of any spirit of antagonism to the American elevator, which I believe to be a good one of its kind, but because the figures illustrate an erroneous kind of reasoning which is very often adopted on this question. —E. B. E.

[1] The figures relating to hydraulic balance ram lifts are incorrect, being founded on a misconception of the arrangement. See my paper on "Hydraulic Lifts for passengers and goods." Proceedings, Inst. Mechanical Engineers, 1882. The economy of different classes of lifts is an entirely distinct question from the relative cost of various kinds of power.—E. B. E.

[2] Fifteen per cent. will not be found too high to cover all repairs and interest at 5 per cent. only, when machinery of this character is working to its full capacity. —E. B. E.

[4] 10 per cent. is taken in this case because the proportion of machinery is much less than with gas or steam, and its durability much greater.—E. B. E. 200,000 foot-pounds of work per minute = 7,500 gallons per day for 200 working days.

[5] The power can be applied direct to either ram or suspended lifts.—E. B. E.

The average cost of power for working a well-constructed passenger lift from the power mains is only 80*l* per annum (lifts being very seldom constructed to carry more than 15*cwt* = 10 or 12 persons)

The most efficient lifts are generally admitted to be those at work on the high pressure system. If such lifts are used and comparison made between private pumping plant, with those parts liable to derangement, in duplicate, so as to give in all respects equal facilities for working, it will, in most cases, be found that the hydraulic power costs little more, and sometimes less, than the interest, wear and tear, and depreciation on the first outlay that may be saved, and the charges are almost always less than the bare working expenses of private plant. Any money, therefore, spent on private pumping machinery is wasted, and if paid for the public power instead would enable the lifts to be worked for several years without any cost at all.

Such calculations as those submitted by Mr. Gibson, apart from other errors, omit from consideration the most important items of cost where pumping machinery is used, whereas the Hydraulic Company's charge is practically the sole charge.[6]

Moreover it may be taken for granted that the public will willingly pay more for the direct hydraulic power than for either gas or steam or re-pumped low-pressure water, as, apart from cost, it is so desirable to get rid, where possible, of all machinery and consequent noise, dirt, and general inconvenience. At the same time the scale of charges adopted for the power is so low that in almost all cases of lifting machinery it is cheapest apart from the other advantages of using the public supply.

There may be special cases in which the economy is not in favor of the public hydraulic supply, but these cases are very rare, and I have not yet come across any building, large or small, in London, where any lifting had to be done, in which the hydraulic power as supplied by the company, with machinery specially adapted for its use, was not the most economical power.

I have also found numerous cases in which considerations of economy in cost of power were secondary, the main question being to obtain machinery occupying little space rapid in action, and being no nuisance to neighbors, either by reason of smell, noise, vibration, or heat and risk of fire.

Then I would add another word about such comparative calculations as I have mentioned. They are estimates only.

When a hydraulic crane or hoist is properly made, it is a very difficult thing to use much more power than ought to be used; every hydraulic machine may be considered as a water power meter in itself.

But with steam engines or gas engines the consumption of coals or gas is a very variable quantity. One set of lifts about to be worked from the power mains in London for 200*l.* per annum now cost, I have been informed, about the same sum for gas alone. Sir Frederick Bramwell, F. R. S., in his recent inaugural address as President of the Institution of Civil Engineers, mentioned that out of six tests of steam engines of various powers, taken at random, working at Birmingham, the coal consumption per I. H. P. amounted to from 9½ pounds to 27 pounds, and the average was about 18 pounds.

We have found in Hull, where steam is supplied by the Hydraulic Company to a few consumers, that, applied to pumping high-pressure water into the mains, and used hydraulically, the same amount of steam will produce four times as much revenue to the company as if applied to work steam engines. When the steam engine and boiler are once obtained waste of coal is not felt much by the ordinary small consumer, but if the steam is supplied and charged for by meter, only very low rate can be paid by the consumer to compete with his own production, owing to his wasteful use of what is supplied. This is well illustrated by a comparison of the charges proposed in Birmingham for supplying power by compressed air with the charges for hydraulic power in London.

A great advantage of the hydraulic power is that the cost of any work to be done is easily ascertained, and, once arranged for, it can be depended on afterwards.

Actual Results Obtained in London.—In London this question of relative economy and advantage has been settled in favor of the public hydraulic power in the first year of its supply. There were a few machines at work before the end of 1883, but the main engines were only started in the autumn of that year, and serious work did not begin until December, 1883. The number of machines working from the mains in January, 1884, was 31. The number at present is 155, and the number contracted to be supplied is considerably over 200.[7] This is a far more rapid result than we had anticipated but its full significance is only to be realized by taking into account the various purposes for which the power is used, and its relation to previous systems in use.

I have prepared a Table of a few typical examples, giving the trades, the number of lifts, cranes, engines, etc., the previous power, the cost of the machinery, the previous cost where known, and the cost of the hydraulic power, and explanatory remarks. The Table speaks for itself. (See Table page 323.)

I should say that so far there has been no attempt to supply the power on any large scale for continuous driving of machinery. I look upon this as a future development of such undertakings when the improvements being effected in high pressure and variable power rotary hydraulic machinery have been perfected. In one well-established instance it has been shown to be practicable and economical, and the hydraulic system was adopted after a careful inquiry into the cost of gas and steam. The charge in this case for hydraulic power was recognised as being in itself higher in amount, but the trade dealt with materials of highly combustible character, and the saving of insurance, the reduced space, wear and tear, and the convenience, turned the scale in favor of hydraulic power; the proprietors have not at all regretted their decision.

Many consumers after a few months' experience have put down further hydraulic plant, and as you will have noticed from the particulars I have given, every known system of power has been already superseded by the public hydraulic system, notwithstanding the cost of the alterations.

In case it may be thought that special inducements have been held out to secure such test cases, I may perhaps be allowed to say that the scale has been rigidly adhered to, and considerable amounts in addition to the current charges are being paid for the extension of mains to buildings situated at such distances from the existing mains as without such additional charges would make the return on the capital expended unremunerative for single consumers.

That the rate of charge for the power from the point of view of the public is not excessive is thus shown, and that the power can be remuneratively supplied at these rates is proved by the fact that the company is already working at a profit.

Notwithstanding the regular increase of the number of machines at work during the autumn and early winter, there was no increase in the consumption to speak of, while the general irregularities of supply are by no means so marked as in Hull. The largest business in the City of London is done in the early spring and autumn, but as the trades are more varied than in Hull, the irregularities are not so great. The full effect of the large increase in the number of machines will not be seen until about six weeks from the present time, when I confidently anticipate a considerable increase in the demand on the mains. To meet the expected demand a third set of pumping engines has been erected at Falcon Wharf.

The inference I draw from this is—if, after all averaging elements in a public supply of power are taken into account, there is still this great variation in the supply, how great must be the waste when each user of power is his own producer, and how misleading are figures based on such machinery being used up to the maximum during the whole year (such as so much cost per day, or so much per horse-power per hour.) Such machinery as I am referring to is never worked up to its maximum capacity for any length of time.

One word as to electric lighting in this connection. We are making experiments for using the power for this purpose. I am confident that the power will be largely so used, but when it is considered that in places of business the ordinary number of hours in which the electric light is needed does not exceed 400 or 500 hours in the year, it will easily be seen how very important an element in the production of the power is the cost of the machinery used, and the rent of the space occupied by it. In fact, storage of some kind seems to be an essential to economy. If storage is used, hydraulic power can be applied at present without difficulty and cheaply by the use of hydraulic engine to drive the dynamos. For continuous use the hydraulic power can be very cheaply supplied, probably as cheaply as gas, and with a much more certain cost, but for electric lighting involving the use of large amounts of power at very infrequent intervals, it will be found that rates at high as 6d per horse-power per hour of actual work would have to be charged, and in many cases could be profitably given.

[6] They assume also that the machinery is worked constantly to its maximum capacity. This is never the case even for a single week, much less over twelve months. The cost of the public power is reduced in proportion to the diminished use—not so the cost of working private pumping plant.—E. B. E.

[7] The normal rate of interest has been from two to three per week since the commencement of supply.—E. B. E.

Treatment of Wood for Street Pavements.*

BY THOS. J. CALDWALL AND THOS. D. MILLER, MEMBERS ENGINEERS' CLUB OF ST. LOUIS.

[Read March 4, 1885.]

The qualities of a perfect street pavement are about as follows: 1. Cheapness (of first cost); 2. Durability; 3. Firmness of foot-hold to horses; 4. Smoothness; 5. Noiselessness; 6. Elasticity; 7. Cleanliness; 8. Impervious ness to water; 9. Agreeableness of color.

"A pavement of wooden blocks possesses every quality of the perfect pavement, with two exceptions: It absorbs moisture to a considerable degree, and after a few years deteriorates very rapidly from decay, in direct proportion to the multiplication of the bacteria, it is retarded when they exhibit low vitality. During this process of decay it offers less and less resistance to the wear of traffic, and finally reaches a condition in which it is unfit for travel, and dangerous to the public health.

"If this decay can be prevented the objection from moisture would not be serious and the wooden pavement would be preferable to almost any other pavement, and for almost every kind of traffic."[1]

The problem of preventing rot in wood gave rise to what is now known as

WOOD PRESERVING.

On account of the abundance of wood, it has always occupied a prominent position in all works pertaining to Engineering. This was particularly so in earlier times, and at the present it cuts a very prominent figure in every structure. The comparative ease and facility with which wood is handled, not to mention the many special advantages which it possesses over other materials in particular cases and especially the advantage of first cost, have conduced to make its use even more extensive. The one great drawback has always been its short period of service, necessitating frequent renewals and repairs, and consequently increasing its ultimate cost. Wood is now used to such extent, that fears are entertained of the near approach of the time when the supply will be entirely inadequate to the demand. The fact has long since been recognized that in subjecting wood to some treatment previous to construction, its life may be considerably lengthened, and thus the ultimate cost reduced, so that in a particular case it is a matter of earnest consideration whether or not it possesses superior merits justifying its employment in preference to other materials. The result is that the business of wood-preserving has become a prominent one, but unlike many other industries, the progress of it has been very slow, principally from the reason that long time is necessary to prove the measure of its utility.

The favorable conditions for putrefaction are the presence of moisture and heat; these exist in a pavement the greater part of the time.

It has been proven by Pasteur, Tyndall and others that "no putrefaction can occur in a nitrogenous substance if its bacteria be destroyed and new ones prevented from entering it. Putrefaction begins as soon as bacteria, even in the smallest numbers, are admitted, either accidentally or purposely. It progresses and is stopped by all influences which either hinder their development or kill them. All bactericidal media are therefore antiseptic and disinfecting."[2]

If some process be found by which, first, the bacteria existing in the wood are killed; second, an antiseptic is introduced that will kill or prevent the development of such as may subsequently be deposited; and, third, the presence of the antiseptic is rendered permanent, we will have a perfect preventive of wood rot.

Tyndall says that some bacteria are killed by a momentary exposure to the temperature of boiling water, while others withstand it for several hours. If the wood be subjected to three or four hours' steaming, at from 240° to 250° F., it will be safe to assume that all bacteria have been exterminated. This, however, is not the only benefit derived from steaming the wood. The pores are opened by the expansion due to the heat, and the steam, condensing, washes out the sap to a greater or less extent, and coagulates largely what albumen remains.

Many antiseptics have been used and numerous experiments made to determine their efficiency. M. Jalan de la Croix experimented on the relative power of various antiseptics in preventing the development of bacteria of putrefaction. Finely divided boiled or raw meat was placed in water; one gramme of the antiseptic was used in all cases, and the figures in the table below give the number of grammes of the decoction in which the one gramme gave the indicated result:

TABLE OF THE RELATIVE POWER OF VARIOUS ANTISEPTICS

	Maximum dose in which development is not arrested.	Minimum dose in which development is arrested.
Antiseptic.		
Alcohol	30	1.77
Chloroform	134	1.
Biborate of Soda	107	14.
Eucalyptol	308	14.
Phenol (carbolic acid)	1,002	10.
Thymol	2,229	20.
Permanganate of Potash	3,041	35.
Picric Acid	3,041	100.
Borated Soda Salicyclate	3,377	30.
Benzoic Acid	4,020	50.
Ethereal Oil of Mustard	5,734	40.
Sulphurous Acid	7,534	72.
Acetate of Alum	7,535	478.
Salicyclic acid	7,677	343.
Bichloride of Mercury	8,358	2,525.
Hypochlorite of Lime	13,092	109.
Sulphuric Acid	16,782	135.
Iodine	20,020	401.
Bromine	20,875	493.
Chlorine	34,509	431.

[1] Report of Board of Public Improvements for the fiscal year ending April 8, 1878, p. 202.

[2] Prof. Cohn, of Breslau.

* From the Journal of the Association of Engineering Societies, April, 1885.

TABLE OF EXAMPLES SHOWING ECONOMY OF PUBLIC HYDRAULIC POWER.

TRADE.	Number of Machines	Description of Machines	Power Previously Used.	Estimated Value of Machinery Displaced.	Value of New Hydraulic Machinery.	Former Annual Cost of Working.	Annual Cost of Working by Public Hydraulic Power Exclusive of Attendance.	REMARKS.
Wharves	3	Cranes	.....	New	1830*l.*	.....	198*l.*	There was a saving of about 1000*l.* in first cost in using hydraulic power instead of steam.
	1	Direct lift						
	2	Elevators and travelling bands						
	1	Pump						
	5	Cranes	4 steam and 1 hand					
	1	Pump	.....	500*l.* old plant	850*l.*	300*l.* assumed	114*l.* including one crane worked formerly by hand	The proprietors stated it previously cost 6d. per ton on 12,000 tons.
	1	Wharf crane	Steam	250*l.*	160*l.*	.....	26*l.*	The proprietor stated he was quite satisfied there was a large saving, and altered the second crane after experience with the first.
	1	Warehouse crane	.....	.....	unknown	.....		
	1	Sack-hoist	Hand	.....	50*l.*	.....	9*l.*	Quite satisfied with the convenience and economy.
	5	Warehouse cranes	Own hydraulic power 700lb. per square inch	500*l.*	.....	.....	125*l.*	Extending the system to new premises.
Warehouses	1	Chain lift	Steam from gas-fired boiler	200*l.*	.....	over 100*l.*	16*l.*	Quite satisfied with the economy obtained.
	2	Chain lifts	Low-pressure hydraulic	.....	150*l.**	166*l.*	65*l.*	* Crediting the parts of old machines removed.
	2							
	7	Warehouse cranes	.....	New	1250*l.*	.....	153*l.*	If any other system had been used many of the machines would have been worked by hand. Proprietors perfectly satisfied. Would not be without it on any account.
	2	Direct-acting lifts						
	2	Chain lifts						
	2	Direct-acting lifts	Own hydraulic power 200lb. per square inch steam for engines supplied by gas-fired boiler	300*l.*	.....	.....	166*l.*	Previous cost unknown, but firm quite satisfied, and now altering all machinery to adapt it to the pressure supplied.
	2	Chain lifts	Hand	.....	.....	.....		
	2	Chain lifts	Own hydraulic power (700 lb. per sq. inch)	750*l.*	.....	unknown	68*l.*	Steam also used for electric light. Hydraulic engine about to be placed in building for working dynamo.
	2	Direct-acting lifts						
	1	Press						
	2	Warehouse cranes	Steam	250*l.*	365*l.*	"	62*l.*	Proprietors quite satisfied with the economy.
	2	Direct-acting lifts						
	1	Chain lift						
	1	Chain lift	Gas engine and shafting	500*l.*	435*l.*	"	54*l.* (est.)	Proprietors first altered one machine, and subsequently all, to work from power
	1	Warehouse crane						
	2	Presses						
Pressing	1	Hop press	Hand	.....	.....	.....	12*l.*	Doing the work of two men.
	3	Hydraulic presses (5000 lb. per sq. inch pressure)	Steam	360*l.*	350*l.*	.....	168*l.*	It was a question of putting in a new boiler or adopting company's power. Understood the company's charges amount to about the same as the coal.
Hotels and chambers	10	Chain and wire rope lifts	Own hydraulic power 700 lb. per square inch, pumps driven by gas engine	1000*l.*	.....	200*l.* for gas only	200*l.*	Existing machinery left as a reserve.
	1	Direct-acting lift	Own hydraulic power 200 lb per square inch, steam pumping engine	900*l.*	.....	360*l.*	250*l.*	If the machinery is adapted to companys' pressure at a cost of 300*l.*, power rate would be 170*l.* per annum.
	1	Suspended lift						
Offices	1	Direct-acting lift	Own hydraulic power 700 lb. per square inch, pumps driven by gas engine	500*l.*	.....	.....	80*l.*	Cost of gas alone stated to be 30*s.* per week. Gas engine objected to because of vibration and smell.
	1	" "	.....	.....	520*l.*	.....	80*l.* (est.)	The great cost of independent power had hitherto prevented a lift being used in this building.
Gas works	1	Crane	Steam	300*l.*	245*l.*	234*l.* less a sum received for steam supplied to a neighbor	78*l.* and say 30*l.* for the second supply.	¾d. per ton 25,000 tons per annum. In this instance it paid two consumers to put up new machinery, and one to sacrifice a rental received.
Factory	2	1-6 H P. and 1-2 H P. engines	Shafting from neighbor	.....	150*l.*	.....	144*l.*	Adopted after a careful inquiry into the relative merits of gas, steam, or hydraulic. Risk of fire in trade considerable.
Coffee grinding	1	Engine	Hand	.....	40*l.*	.....	16*l.*	For rivetting up a bridge. Cost saved of putting down pumps, engines, and accumulator, and of attendance.
Rivetting	2	Portable rivetters	.....			.....		

NOTE.—It is only in a very few cases that there is an opportunity of knowing the exact cost of working by the displaced systems The cost of the hydraulic power as stated, is for the water used only, the maintenance in all cases is very small (under 5*l.* per annum per machine) and no skilled men are required to look after the machinery. The exact figures are, however, of no material moment, the object being to give the approximate cost for different classes of work, and to show by actual examples that considerable amounts are being expended or sacrificed by consumers in order to utilize the public supply.

Several of the above have been used for the preservation of wood. In this connection should be mentioned compounds of zinc, lead, copper, iron, arsenic, lime and creosote oil.

The action of the aqueous solution of the metal salts is to coagulate the albumen of the sap, besides its action as an antiseptic. The action of creosote oil is the same, while it fills the pores of the wood with a bituminous asphaltic substance which gives a waterproof coating to the fiber, preventing the absorption of moisture.

The following abstracts give a brief history of wood preserving:

1737. Mr. Emerson patented a process which consisted in saturating timber with boiled oil mixed with poisonous substances. This is believed to be the first patent on a process for preserving wood.

1740. Mr. Reid proposed to arrest decay of wood by means of a certain vegetable acid.

1756. Dr. Hales recommended that the planks at the water-line of ships should be soaked in linseed oil.

1758. Du Hamel and Buffon experimented on a process for preserving wood, but with no satisfactory results.

1769. Mr. Jackson proposed the use of salt water, lime and potash salts.

1773. From 1768 to this date the practice of saturating ship timbers with a solution of common salt prevailed.

1779. Mr. Pallas, in Russia, proposed to steep wood in a solution of sulphate of iron and then in a solution of lime to precipitate the vitrol.

1784. M. Megueron worked on a process for preventing decay.

1796. Hales proposed to creosote the treenails of ships. This was 42 years prior to Bethell's patent for creosoting.

1805. Mr. Maconochie proposed to saturate inferior woods with resinous and oily matters.

1811. Cadet de Gassicourt tried mineral substances and unguents.

1813. M. Champy suggested a bath of hot tallow.

1815. Mr. Wade proposed a caustic alkali solution of common resin. Soaked the timber in the solution, and afterward plunged it in into acidulated water. He also recommended solutions of sulphates of copper, zinc and iron. Mr. Boyden boiled the timber in lime water and then in a thin solution of glue.

1817. Mr. Chapman recommended sulphate of copper, and bichloride of mercury.

1822. Mr. Oxford patented a process which consisted in saturating oil of tar with chlorine gas and mixing with it finely ground carbon of purified coal tar, oxide of lead and carbonate of calcium, and applying the composition in thick coatings.

1832. Mr. Kyan patented his process of treating with bichloride of mercury which has met with considerable success. Closed vessels and high pressure were first used in charging the timber in this process.

It was proposed in America to apply pyroligneous acid to the surface of wood or to introduce it by fumigation.

1835. Franz Moll, a German, proposed the use of creosote in a state of vapor, but it was attended with great expense.

1837. Boucherie's process of impregnating with copper sulphate was very successful and was extensively used.

Mr. Flockton used wood tar and acetate of iron. This is thought to have been a failure.

1838. From 1831 to 1838 Bréant operated in France with a mixture of linseed oil and resin. In 1838 he patented the method of impregnating by atmospheric pressure.

Mr. Bethell patented his process of creosoting. It was suggested to him by his observations on mummies. The process found great favor, and was extensively used in England, Scotland, Ireland, Belgium, Holland, France, Prussia, India and America.

1840. Between 1838 and 1840, Sir William Burnett introduced his process of treating with zinc chloride, impregnating under pressure as high as 150 pounds per square inch.

1846. The Burnettizing process was carried from England to Bremen, and by 1851 had spread over Germany and Austria.

As the above chronology shows, a great number of methods have been used; but few, however, have proven successful. At least three, when well executed, can be relied upon to prolong the life of wood. These are, essentially, Kyanizing, Creosoting and Burnettizink, and are too well known to warrant a minute account of them here.[3]

Kyanizing.—Mr. J. B. Francis says: "I have specimens of cottonwood, kyanized nearly twenty years ago, which have been in the ground ever since, and are still sound, the wood retaining its strength and color, while other specimens, not treated, and under the same exposure, have so completely decayed as to become nothing but black mould."[4]

And as will be seen, from the table of experiments by M. de la Croix, bichloride of mercury possesses more

[3] See Trans. Amer. Soc. of Civ. Engrs., 1882; Proceedings of Engrs', Club of Philadelphia, Vol. 1, 1880; Proc. Inst. Civ. Engrs., Vol. 78.

[4] Trans. Amer. Soc. C. E., 1882.

than five times the antiseptic powers of any of the other substances determined. However, this process seems to have fallen into disuse, and, so far as we can learn, has never been used in paving blocks to any extent.

Creosoting consists in impregnating the wood with dead oil.[6]

"Numerous instances of pavements laid with blocks preserved by this process may be found in our cities, which have remained sound for many years, but there are also instances where timber impregnated with creosote has failed to give satisfaction. The fault in such cases may be assumed to be either in incomplete impregnation or in the poor quality of the material used. Full impregnation can easily be secured by thorough supervision and inspection of the work, but it is very difficult to secure the proper material, not only for the reason that the original chemical constituents of the tars, from which the heavy oil of tar (generally called creosote) is gained by distillation, differ very much, but because the final product for preserving purposes depends greatly on the extent to which distillation has been carried. If the proper proportion of ingredients in a good creosote could be stated with exactness, and if chemical analysis could readily determine the quantity of the various ingredients present in a creosoting fluid proposed to be used, complete success of the process could be assured in all cases. But as neither of these conditions can be readily filled, certainty of success cannot be warranted, as it can in the case of impregnation with metal salts, except under a system of the most rigid and expensive supervision."[6]

Burnettizing consists in injecting into the timber a solution of chloride of zinc ($Zn Cl_2$).

Mr. J. W. Hobart, in a letter written April, 1882, to Mr. O. Chanute, says "an old side track was removed which had not been in use for several years, and which was nearly covered with earth and grass, still the hemlock ties were then found nearly sound, having laid there for nearly 25 years. * * * There is no doubt that the preservation of these ties was due to this process."[7]

There is abundant evidence of the efficiency of chloride of zinc as a preservative. It has passed from the field of experiment and become an established fact.

In earlier times the manner of impregnating the wood was by soaking, but this was not found to be effective within a short period. Therefore, closed tanks and pressure were introduced, which is the practice to-day.

The methods employed for incorporating the antiseptic may be divided into two classes, *viz* : the direct and the indirect. In the direct method the wood is subjected to the action of a single solution, which may be either simple or compound. In the indirect method the wood is subjected to the action of two solutions, one following the other, both or either of which may be simple or compound. By the direct method the antiseptic is introduced bodily into the wood in the solution. By the indirect method the antiseptic may or may not be introduced at once in the first solution, and the second solution may be for a single or a double purpose; for a single purpose when the idea is to effect such a tranformation as will tend to fasten the antiseptic which has already been introduced; for a double purpose when the idea is to effect such transformation as will not only tend to fasten the antiseptic, but also simultaneouly the antiseptic itself is the outcome of the transformation. As illustration of the indirect method, take the simple Burnettizing process. As illustration of indirect method take the zinc-thilmany process, where the first solution is the sulphate of zinc ($Zn SO_4$,) and the second solution is chloride of barium ($Ba Cl_2$). The introduction of the latter solution is based on the idea that such transformations are effected as will not only form the antiseptic zinc chloride, but also that the antiseptic may be preserved intact by the fixing action of the barium sulphate ($Ba SO_4$), which is one of the results of the transformation.

In this city there are two Wood-Preserving Companies: The St. Louis Wood-Preserving Company, and The American Wood-Preserving Company. The former company use the zinc-tannin process, and the latter company use the zinc-gypsum process and creosoting process.

In the year 1880, the St. Louis Wood-Preserving Company erected additional appliances at their works, and were engaged by the city to treat material for street pavements by the zinc-thilmany process. The following were specifications in the contract, viz.:

1. Steam the blocks 3 hours at from 15 to 18 pound pressure (not to exceed 240°.)
2. Apply vacuum 20 minutes at 5 pounds pressure.
3. Apply $Zn SO_4$ solution 2 hours at 80 pounds pressure (1st injection).
4. Apply vacuum 5 minutes at ½ pound.
5. Apply $Ba Cl_2$ solution 2½ hours at 80 pounds (2d injection).
6. One half of one per cent. of $Zn Cl_2$ to remain in every part of the blocks. On the assumption that the average weight per cubic foot of gum wood was 40 pounds, and that it absorbed 30 per cent. of its volume of the first solution, and on the supposition that the two solutions exactly neutralize each other bulk for bulk, each occupying one-half of the absorption, it was found that to realize this one-half of one per cent. of $Zn Cl_2$, the $Zn SO_4$ solution should be 2½ per cent. strength and the $Ba Cl_2$ solution should be 3.2 per cent. strength. In the operation of the process it was observed after steaming the wood that ⅓ of the first solution penetrated the wood immediately upon being let into the cylinder, and the remaining ⅔ required the hydrostatic pressure. It was also noted that only ⅓ as much of the second solution as of the first could be forced into the wood, or, in other words, the wood was sur-charged with the first solution and the transformation consequently effected were far short of the requirements. The average results obtained by this treatment in five gum blocks were as follows:

Average ¼-inch from end of block— .21 per cent. $Zn Cl_2$.
" 1 " " " — .04 " "
Center " — .30 " $Zn SO_4$.

On one occasion the second solution remained 30 hours in contact with the wood under a set pressure, and the results obtained showed a large increase, viz.:

Center of block— .48 per cent. $Zn SO_4$.

After these blocks dried out the precipitated barium sulphate was found to vary on the opposite ends of the same block, and that there was a wide difference in the quantity the several blocks received, although apparently under the same conditions.

On opening the cylinder the blocks were found to be heavily coated with barium sulphate, and it is more than probable that the instantaneous transformation to the precipitate barium sulphate on the fibre ends of the blocks so filled up the pores that a slight reaction was all that could be effected further in the blocks. Long contact with the second solution gave better results, but in operating any process the long contact necessarily adds greatly to the cost, and consequently precludes its practical use. Were it practicable to give the blocks as much of the second solution as of the first the expected results would be realized.

The Zinc-Tannin process consists of a solution of $Zn Cl_2$ and gelatine for the first solution, and the second a solution of tannic acid. Chemically considered, gelatine is precipitated by tannic acid and forms leather, the idea being that this formation of leather in the pores of the wood protects the $Zn Cl_2$, the presence of which is already assured.

The following analyses were made of blocks treated by the zinc-tannin process, and show to some extent how successful this method is:

Average ½ inch from end of block— .89 per cent. $Zn Cl_2$.

Description.	No.	Time in Pavement.	Part of Block Analyzed.	Per cent. $Zn Cl_2$.
5in. gum block	a	2 years	Center	44/100
" " "	b	3 "	"	7.4/100
" " "	c	3 "	"	1.00/100
" " "	d	3 "	"	7.0/100
" " "	a	2 "	Top	1.00/100
" " "	a	2 "	Bot.	1.00/100
" " "	b	3 "	Bet. 1in. & ½ in. from bot.	1.00/100
" " "	c	3 "	" " " " "	1.25/100
" " "	d	3 "	" " " " "	1.25/100

These blocks were steamed for 3 or 4 hours at about 18 pounds pressure, and the zinc chloride solution was applied for 3 or 4 hours at from 95 to 100 pounds pressure, and then the tannin solution was applied for 2 or 3 hours at from 95 to 100 pounds pressure.

TABLE GIVING THE CORRESPONDING DEGREES FAHRENHEIT FOR POUNDS PRESSURE STEAM.

Temperature of steam Fahr (T.)	Pressure in lbs per sq. inch (P)	Difference of pressure for 1° temperature (D. P.)	T.	P.	D. P.	T.	P.	D. P.
					419			599
212	0.00		235	8.12		260	20.80	
		294			426			607
		304			452			642
215	90		240	10.30		265	23.92	
		310			458			651
		330			485			687
220	2.50		245	12.65		270	27.26	
		335			492			696
		358			520			733
225	4.23		250	15.18		275	30.83	
		364			527			743
		388			559			780
230	6.10		255	17.89		280	34.63	
		394			567			790

The Zinc-Gypsum process consists of a single solution of zinc chloride and gypsum ($Ca SO_4$) injected into the wood. Gypsum is soluble in a solution of zinc chloride, and it is claimed that when the wood becomes dry the gypsum crystallizes out and thus protects the zinc chloride which has accompanied it.

It is impossible to state how effective this method of fixing the antiseptic in the wood is, because no work done by this process has been down for a length of time sufficient to determine even partially as to the validity of the claim, the only true guide being actual service. Experiments made by us show that gypsum is readily dissolved by a zinc chloride solution, which, on being allowed to evaporate to dryness, leaves a residue of zinc chloride and crystals of gypsum, all of which re-dissolves upon the addition of water. We are therefore inclined to the opinion that, as the double solution cannot deposit more gypsum in the wood than the zinc chloride solution carries there, the introduction of water into the dry-treated wood will re-dissolve the zinc chloride, which in turn takes up the gypsum as effectively, perhaps not so rapidly, as it would the zinc chloride alone.

During the process of steaming wood the pressure should never be allowed to rise above 15-18 pounds per square inch, as beyond that point the temperature is such as to become injurious to the wood. The above table gives the corresponding degrees Fahrenheit for pounds pressure steam:

The pressure necessary with a 2 per cent. solution to impregnate a 5 or 6-inch gum block, leaving 25/100 per cent. zinc chloride in the center, within a limited time (say 4 hours,) is little less than 100 pounds per square inch. Experiments made by Mr. J. P. Card, President of the St. Louis Wood-Preserving Co., show that steamed wood takes solution readily without pressure, to a limited extent, then it absorbs it very slowly, and, if 10 pounds pressure be applied, it again takes solution rapidly to a certain point, when it almost stops; and so on, with a decreasing scale, up to 100 pounds, beyond which it is very stubborn, pressure or no pressure. With a pressure of 100 pounds and a 2 per cent solution, more than 25/100 per cent. of zinc chloride can be injected into every part of a 5 or 6 inch paving block inside of four hours. This conclusion is supported by the results of analyses made by us. Six-inch gum blocks treated with a maximum pressure of 40 pounds for four hours show, from nineteen analyses of their centers taken across the fibre, an average of 1/100 per cent. zinc chloride. The number of blocks for each analysis ranged from one to four, the highest result being 2/100 per cent., the lowest 1/100 per cent. Five-inch gum blocks treated with a maximum pressure of 100 pounds for 3½ or 4 hours show from seven analyses of their centers, taken across the fibre, an average of 36/100 per cent. zinc chloride. The number of blocks for each analysis ranged from one to six, the highest result being 67/100 per cent. zinc chloride, the lowest 25/100 per cent. zinc chloride. A 2 per cent. solution was used in all cases.

Frequently, with two or more charges treated in precisely the same way, with all conditions similar, the analyses gave different results, which can be accounted for in no other way than that the difference in the structure of the wood examined was the cause.

In order to determine how nearly uniform the zinc chloride was distributed through the blocks, three examinations of 6-inch gum blocks were made. Sliced block No. 1, a white gum, was cut across fibre into 11 equal slices, and each slice analyzed. Sliced block No. 2, a white gum, was cut into 12 equal slices, across fibre, immediately on coming from the cylinder, and each slice analyzed. Sliced block No. 3, a red gum, to all appearance a duplicate of No. 2, and treated in the same charge, after coming from the cylinder was placed with its fibres horizontal and allowed to thoroughly dry, when it was cut and analyzed in the same manner as No. 2. The results are as follows, which, for the sake of comparison, have been platted, taking the horizontal line for the scale of slices and the vertical line for the scale of per cents. These blocks were treated by the zinc-gypsum process in the summer of 1884, at the time the blocks for the Chestnut street pavement laid in this city in that year were treated. They were steamed 6½ hours, at 30 lbs. pressure, and were in a 2 per cent. solution 12 hours, at 40 lbs. pressure.

No. Slice.	Block No. 1. per cent. $Zn Cl_2$.	Block No. 2. per cent. $Zn Cl_2$.	Block No 3, per cent. $Zn Cl_2$.
1	989	2.440	1.842
2	776	1.086	212
3	293	352	163
4	118	209	062
5	067	133	045
6	054	080	084
7	045	131	057
8	056	134	074
9	072	183	064
10	092	285	107
11	295	720	158
12	...	2.174	1,653
Average	260	661	377

Examinations of s. b. No. 2 and No. 3 were made for the purpose of determining to what extent, if any the zinc chloride became diffused through the block while it was drying. Notwithstanding the two blocks were of different kinds of gums, there is no evidence that diffusion trkes place to any extent, but would seem to indicate that the solution exudes somewhat. The average of s. b. No. 2 lies between the second and third slices from either end; of s. b. No. 3 the average lies between slices Nos. 1 and 2, 11 and 12. Assuming the impregnation to have been equal, there has resulted a shifting of the average during the drying as much as ½ inch from the center toward either end. Slices 4 to 9 of s. b. No. 3, when compared with those of s. b. No. 2, apparently show that there has been some equalization in the block while drying.

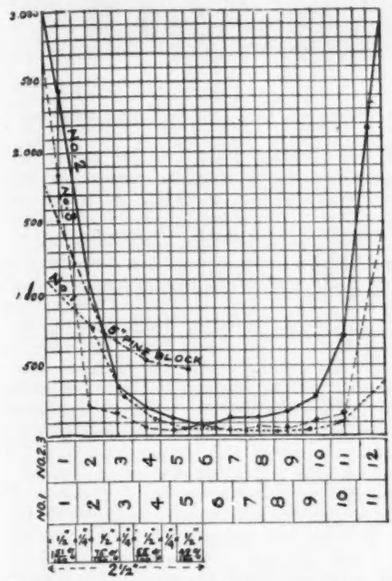
It will be observed that the curves are considerably higher on one side than on the other, which shows that the solution enters more freely from one end than from the other. This result is due to the valves of the sap vessels. The solution, entering from the tree-top end

[6] See Proceedings of Engineers' Club of Philadelphia, Vol. 1.

[6] Report of Board of Public Improvements for fiscal year ending April 11, 1881.

[7] Trans. Amer. Soc. Civ. Engrs. 1882.

of the block, meets with resistance from these valves, while from the other end, the valves are acting as in the natural tree and offer no resistance, but may facilitate the absorption and prevent the exudation at this end when the pressure is removed. It is an established fact that posts set tree-top end down last much longer than when in the natural position. This phenonenon is also due to the action of the valves of the sap vessels. In the post set in its natural position the valves act so as to hold what moisture may be drawn into the wood by capillary attraction and thus facilitate decay, while



in the post reversed the action of the valves is to resist the entrance of moisture. Now, in a wood pavement with a water-tight concrete foundation the moisture comes from above, and it seems, could inspection be carried to this extent, that the life of the wood would be lengthened were the blocks placed in the pavement tree-top end up. The blocks would, at least, then be in a position to best resist the dissolving action of water in carrying off the antiseptic.

Various kinds of wood differ very materially as to their power of taking solution. Analyses made of a sample taken from the centers of six 5-inch pine blocks, and of a sample taken from centers of six 5-inch gum blocks treated as the same time show for

Pine, weight per cubic foot 25.7 lbs. $\frac{60}{100}$ per cent. $ZnCl_2$

Gum, " " " 32.0 " $\frac{38}{100}$ " "

or the impregnation of pine is to gum as 100 to 62 when estimated by per cent. These blocks were treated with zinc chloride, steamed 4 hours as 18 lbs. pressure; in solution, 3 hours at 100 pounds pressure.*

It will be observed that the average weight per cubic foot of the pine blocks was only 25.7 pounds and that of the gum blocks was 32.0 pounds. Where the pine showed $\frac{60}{100}$ per cent. $ZnCl^2$ the gum showed only $\frac{38}{100}$ per cent. $ZnCl^2$, whereas if the gum had taken $\frac{60}{100}$ per cent. it would have contained actually as much of the antiseptic as the pine, or if the pine had taken only $\frac{38}{100}$ per cent. $ZnCl^2$, it would then have contained actually as much as the gum with $\frac{38}{100}$ per cent. The conclusion is therefore obvious, that where the quantity of material to be incorporated is specified by the per centum, the weight per cubic foot of the wood should be considered.

Inspection.—The inspection of paving blocks should be made before treatment, because after treatment the blocks are found to be so discolored as to defy the detection of bad ones.

Chemical analyses should be made, at intervals, of the solution used, as the hydrometer test can not be relied upon for an indefinite time.

In order to insure the success of the process, a chemical examination of a sample from each charge, or run, should be made.

All methods of preserving timber depend for their success upon the skillful and conscientious manner in which they are executed, for as they involve chemical action on a large scale, their efficiency must depend upon the observance of the minute practical precautions required to exclude disturbing causes.

Statistics can be adduced which prove conclusively that wood treated in a proper way is of the most decided economy; but, in view of the fact that the failures of treated wood pavements are traceable to improper or imperfect treatment, to bad foundations or to the physical properties of the wood used, treated wood for street pavements can as yet be considered as scarcely more than an experiment.

It will, of course, be conceded that a wood which will wear out before it begins to rot will in nowise be benefitted by treatment.

The first desideratum for a treated wood pavement is a wood which combines a maximum of wearing quality with a minimum of expansion and construction together with a minimum of cost. Such a wood, well treated and carefully laid on a proper foundation, would undoubtedly give decidedly economical results.

* We intended to present similar analyses of spruce, hemlock, oak, elm, cottonwood, and others, but through some misunderstanding the blocks were not treated in time for the analyses to be made.

Phosphor and Manganese Bronzes.

Phosphor-bronze is an alloy in which copper is mixed with some thousandths of phosphorus. There are some special bronzes used which are very hard and which contain as much as a two-hundredth part of the latter ingredient.

The first introduction of this alloy into the industrial arts dates back to 1854, when Messrs. Ruolz and de Fortenay made, in phosphor-bronze, several pieces of artillery at Douai and at Strasbourg. These experiments called out a ministerial decision in February, 1860, authorizing an alloy of silver rendered possible by the admixture of a certain quantity of phosphorus with the copper.

The methods employed were kept secret until 1870, when the process was divulged and made use of in foreign industries. It is always in the form of phosphoretted copper that the incorporation is brought about. This mixture, as introduced by Messrs. Ruolz and de Fortenay, was made by mingling in a plumbago crucible, red copper, acid phosphate and wood charcoal, there being at least 9 per cent. of phosphorus in the compound. With this standard of volume, it is very stable and the metalloid is not lost in the remelting. There is made at the present time, by M. Guillemin a phosphuret with 14 to 15 per cent. of phosphorus and 10 per cent of tin.

The industrial uses for alloys containing from a half-thousandth to three thousandth part of phosphorus are now many and important. Since 1872 the *Compagnie d'Orleans* have used this phosphor-bronze to a certain extent, and now exclusively, for journal-boxes, slide-valves, etc., on their railway. These bronzes have great homogeneity, a notably increased tensile strength, a hardness easily graduated to resist wear, and they are reasonable in price.

As used for various purposes, excluding the phosphorus, the composition of bronze is as follows:

	Copper.	Tin.	Zinc.
Locomotive slide-valves,	80	11.5	8
" boxes.	77	11.5	11
Car boxes,	75	8	17
Portions of machinery,	88	8	3.5

The bronze for telegraph or telephone wires contains about 4 per cent. of tin, and there are now found in commerce good alloys of a standard of 10 per cent. tin and 90 per cent copper, with a very little phosphorus.

The quantity of the phosphuretted copper added in the mixture varies, on the Orleans railway, from 2½ to 3½ per cent.; one part of the phosphorus, is absorbed in the reduction of the oxides of tin and makes possible the complete refining of the bronze; it is this fact which increases its homogeneity.

The phosphoretted alloy is more fusible, and the physical character of the melted metal is no longer the same; for while the ordinary bronze, when melted, is a dull dirty red in appearance, and presents a calm surface; the surface of the phosphor-bronze is in a boiling condition and a peculiar gyratory motion is produced over this surface, which can be easily recognized when once seen, even when the proportion of phosphorus does not exceed one-half thousandth part.

The peculiar fluidity of the metal due to this admixture of phosphorus has the inconvenience of permitting the fused metal to be absorbed by the sand in the mould, were not this sand surface protected and hardened by plumbago mixed with molasses.

The metal, besides the uses previously stated, is employed in the utensils for powder-making, because no sparks can be drawn from it by shock; and the telegraph wires made from it are almost perfect against oxidation, almost as strong as steel, and have a conducting capacity double that of galvanized iron wire.

The Manganese-bronzes are distinguished by possessing the property of being readily forged at a red heat. Some thousandth parts of manganese improve the quality of the zinc-bronzes and increase their tenacity. Experiment has proven, however, that when the proportion of tin in bronze exceeds 8 or 9 per cent. the manganese will separate from the alloy. The manganese is preferably introduced into the mixture immediately before the casting, in the state of cupro-manganese, a product containing 75 per cent. of copper and 25 per cent. of manganese. It is probable that this cupro-manganese acts upon the bronze in the same way that ferro-manganese operates in the manufacture of mild steel; it refines it and reduces the oxides and improves by its presence in the fluid metal, certain of its properties.

The following are the figures resulting from experimental tests of its physical properties:

	Cast Metal	Forged Metal
Resistance to rupture	35 to 38	45 to 47
Limit of elasticity	22	19 to 21
Elongation	4 to 8 per ct.	20 to 30 per ct.

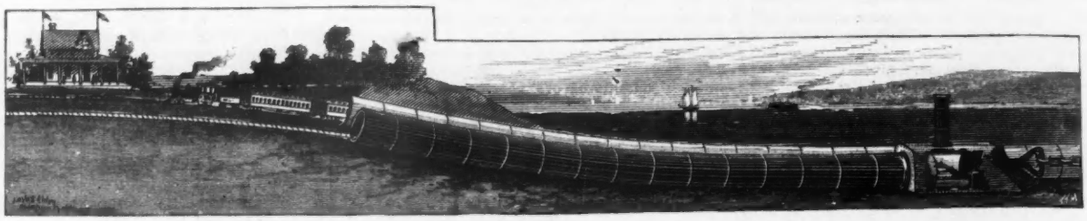
The above properties are almost those of mild steel.—*Le Génie Civile.*

A New Process for Hardening Plaster.

A new process for rendering plaster very hard, and capable of being substituted for wood in flooring has been brought out by M. Julhe. Plaster has this advantage over cements, and even over wood, that it increases rather than diminishes in bulk on being applied to structures; but it fails in hardness and surface resistance. To overcome this difficulty M. Juhle mixes six parts of good plaster with one part of rich lime, recently slaked and finely sifted. This mixture is to be used like ordinary plaster, and the object made from it when it is very dry is caused to imbibe a solution of a sulphate which has a base precipitable by lime, and this precipitate insoluble. Such are the sulphates of zinc or iron. The theory of the process is as follows: The lime contained in the pores of the plaster decomposes the sulphate, with production of two insoluble bodies, to wit, sulphate of lime and oxide, which fill the pores of the object submitted to the treatment in question. With sulphate of zinc the object keeps of a white color, but with sulphate of iron the object at first greenish, takes on drying and with lapse of time the color of the sesquioxide of iron. With sulphate of iron the hardest surfaces are obtained, the resistance to rupture being twenty times greater than with ordinary plaster.

To obtain the maximum hardness and tenacity it is necessary that the object should first be very dry, and steeped in a solution which is practically saturated. The first immersion of the object in the solution ought not to last over two hours, as a too long immersion at first is apt to render the surface friable. On drying the plaster object afresh after the first immersion, there is no further fear of its becomming friable. If the proportion of slaked lime is too great the surface is apt to take a very hard marble-like skin which prevents the hardening of the inner portions of the object. The proportions of one of lime to six of plaster as stated above has given the best results. Plaques made in this way can be browned by rubbing them with linseed oil and litharge, and glazed on the surface with hard copal varnish. A beautiful glassy flooring like polished oak can in this way be prepared.—*London Engineering.*

THE HALL SUBMARINE TUNNEL.



The Hall System of Subaqueous Tunneling.

A week or two ago ENGINEERING NEWS made some remarks about this system of tunneling under waterways, but lacking data the description was unsatisfactory. Further information and an examination of the models, etc., enables us to give the following and more full detail of the method.

The invention is that of Mr. Hayden H. Hall, and it has for its purpose the economical tunnelling of streams at such points where bridges are either too costly or impracticable. The method has been successfully applied in laying a double line of large water mains across the harbor of Sydney, Australia, in water 45 feet deep and over a length of 1,230 feet, and its adaptability thus practically tested.

As applied to a railroad tunnel, for example, the operation would be conducted about as follows: Suppose the tube is to be 18 feet in diameter, this shell would be made of heavy sections of chilled white cast-iron, 3 inches or more in thickness, as the depth below the surface may demand, and connected by inside flanges and bolts: these plates can be cast directly from the cupalo without any remelting by a process for which Mr. Hall holds patents for the moulds to be used and the casting and chilling of the segments; the patents also apply to the use of white chilled iron for the purpose named. At the present market price the plates would cost about $14. per ton ready for use, making the cost of a tunnel of the dimensions given about $84 per lineal foot.

This chilled white iron is a comparatively cheap product and is practically non-corrosive in sea-water, as has been proven by its exposure during twelve years in Sydney harbor without any material injury.

The above cut shows one tunnel completed and the other in process of construction; the two in practice would be built separately, the one finished or nearly so before the other is commenced. The plow-shaped caisson, at the unfinished end is provided on its inner end, with a stuffing-box, slightly eccentric in outline but made water-tight around the tunnel proper; this box is quite thin at the bottom so that the tunnel and the bottom of the caisson are practically on a level line.

Inside the caisson are heavy iron anchoring piles to prevent any motion due to lateral currents in the water-way; these piles are worked from the inside through stuffing-boxes. Under the forward ends of the caisson are also hinged fins or bearing plates which can be depressed or raised by screws, so as to in a degree control the vertical motion of the caisson. Lateral or vertical curves in the tunnel are made possible by appropriate segments of shell cast to conform to the desired curvature.

In building a tunnel, a start is made from one of the shores by first dredging out the desired depth of channel and then fitting a few sections together until the tube can be made to enter the stuffing-box in the caisson and the joint made water-tight by a rust joint. Another section is then assembled inside the caisson, and this latter is moved ahead one length by power applied from the water surface to the clevis shown in front of the caisson. This operation is repeated until a sufficient number of sections have been put together to make the structure firm enough to resist the action of from two to six hydraulic jacks applied to the rim of the completed tunnel on the inside of the caisson, when exterior force may be dispensed with.

The caisson is ballasted with lead to overcome its buoyancy, and by the careful adjustment of this load and the proper manipulation of the jacks the forward motion and direction of the tunnel is controlled with the aid of the fins before mentioned. The bottom of the caisson is rounded if the channel is to be excavated, or flat if the tube is to be laid directly on the bottom; the latter form being adopted to overcome any rocking motion in the caisson. If desirable a connection with the surface can be maintained by a vertical shaft entering the top of the caisson, but as this invention proposes to keep up a direct and free communication with the shore through the finished tunnel this shaft is not necessary. Air can be supplied and material forwarded through the tube; the track is laid as the tunnel is built and the car running on this track is provided with appliances for lifting a 10-ton segment of the shell into position for bolting; a 12-horse-power engine running by compressed air and located in the caisson furnishes the power required, as well as working pumps for the jacks and other pumps for the discharge of any leakage water.

Where the depth of water will permit it the tunnel is laid directly on the bottom of the channel; otherwise a trench is dredged as close as possibly to the required level ahead of the tunnel, leaving the plough-shaped prow of the caisson to complete the levelling process. If the bottom of the channel is a stratified rock, the grade of the tunnel is adapted as nearly as possible so as to follow this stratification; but if this is impossible the rock and boulders in the path of the caisson must be previously removed by submarine blasting, and a sand, or gravel filling added to smooth off the surface and afford an even bearing. As it is not contemplated to apply this system at depths exceeding 60 or 65 feet, this subaqeous work of rock-blasting and levelling is comparatively inexpensive.

The advantages claimed for this system by its inventor are:—that it brin s the grade much higher than any tunnel through the solid; that this is especially advantageous in treacherous ground; that all excavation is done from the water surface by dredging or other inexpensive methods; that compressed air is not used, but the connection with the shore or surface can always be maintained; that the protection against the inroad of water is absolute, and is not dependent upon the nature of the material penetrated, as in other tunnels, or upon internal air pressure. The material proposed for the shell is, in itself, cheap and lasting, though a lining of brick-work can be readily put in place, and would be doubtless necessary to overcome the bouyancy of the empty tube. While the device might require careful handling, and some further improvement in detail when applied on a large scale, it certainly has many good points which commend it to the attention of those interested in crossing water-ways by other than bridging methods.

Erection of a Concrete Bridge in One Day.

The firm of Zurlinden & Co., of Aarau, having constructed a canal in connection with their works about two-thirds of a mile in length, were obliged by the town authorities to bridge it in two places. This they did by means of segmental arches of cement concrete constructed to the designs of Professor Tetmajer, of Zurich. The dimensions of the arches —Proc. Inst. C. E.,—are: Span, 39 feet 4 inches; rise, 6 feet 6¾ inches; thickness at crown, 1 foot 7¾ inches; thickness at abutments, 3 feet 3½ inches; thickness of abutments, 9 feet 10 inches; width of roadway, 13 feet 1½ inches. The foundation of both abutments is on fairly good gravel, at a depth of about 5 feet below the springing. Spandril walls are carried up to the level of the roadway, and surmounted by an iron hand-rail, the space between the spandrel walls being filled in with gravel covered with ordinary road metalling. The total weight of the structure between the abutments is 194 tons, or, including a live load of 300 kg. per square meter—61.5 pounds per square foot—211 tons. The first bridge was erected in two days in June, 1884, the two abutments being formed on the first and without the arch and spandril walls on the second day. The bridge was brought into use after standing for about two months, and has been in constant service ever since for heavy-wheeled traffic any sign of settlement or cracking.

On the 9th of October the second bridge was completed between 6 A. M. and 6 P. M. by 65 men. The concrete was mixed in accordance with the recommendation of Professor Tetmajer, as follows: The cement and sand were first mixed dry, then the gravel added, water being gradually added during the mixing in such quantities that when the punning of the concrete was completed a thin film of water showed upon the surface. The concrete was mixed as follows:

	Cement vol.	Sand vol.	Gravel vol.	Pounds of cement per cu. yd. of concrete
Abutments	1	3	7	337.2
Arch	1	2	4	505.8
Spandrils	1	2	6	421.5

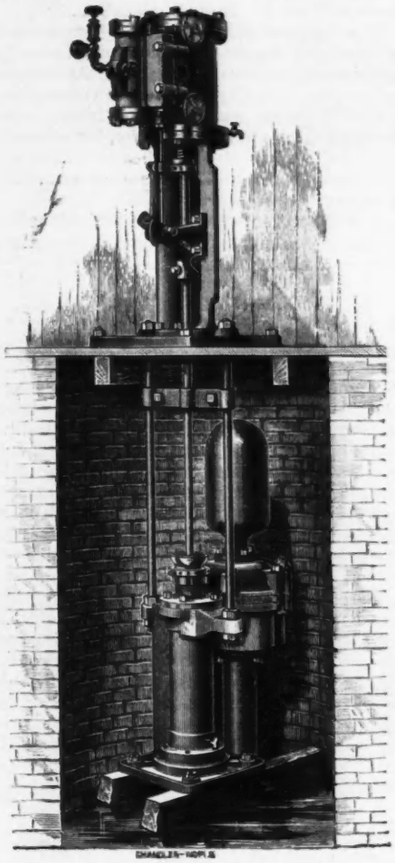
The cost of each bridge is given in *Le Génie Civil* as follows:—

Excavation; 50 cu. metres at 1 franc per metre	50 fr.
Beton and centers; 80 cu. metres at 31 fr. 25c.	2.500 "
Roadbed and filling	210 "
Hand Rail	260 "
	3.020 fr.
or	$604.00

London Death-rate Investigation.—In London an important modification has been made in the manner of investigating the death rate. The old way was to give the entire rate of the city in lump form. The change consists mainly in the systematic redistribution into their respective districts of the deaths of persons habitually resident in them, but dying in one of the institutions. In the first quarter of 1885 the death rate for all London was equal to an annual rate of 21.5 per 1,000 of population. Under the new plan, the rates from which the foregoing figures were made were as follows for the thirty-nine sanitary districts of the city: The lowest were Plumstead, 14.9, Hampstead, 16.3; Kensington, 16.6; Lewisham, 18; Hackney, 18.9; and St. George's Hanover square, 19. The higher rates were found in London (city), 28.2; St. Saviour's, 28.7; St. Luke's 29; St. Giles, 30.5; Holborn, 30.7; St. George's-in-the-East, 35.7.

New Pump Designs.

The accompanying illustrations show several new forms of pumping machinery made by the Dean Brothers, of Indianapolis, Ind.

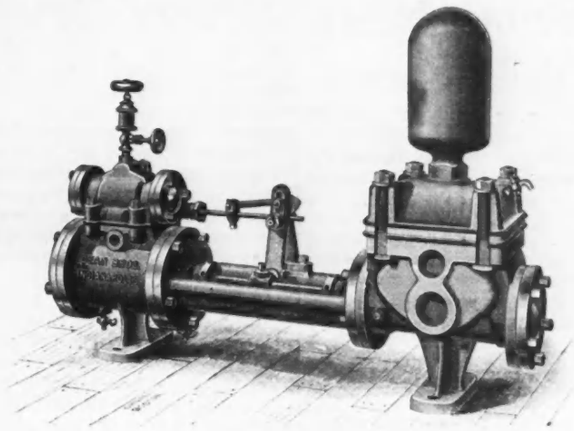


VERTICAL PUMPS FOR DEEP WELLS OR MINES.

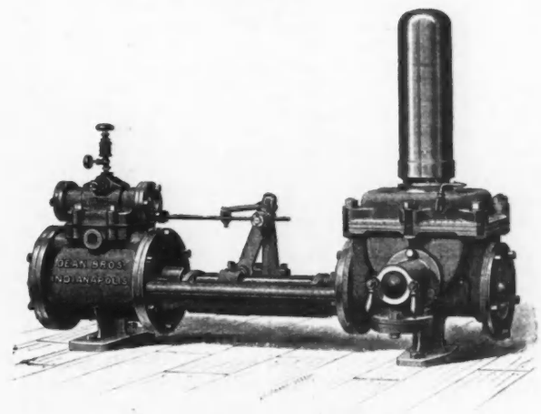
The boiler feeder shown is from entirely new designs. Its main features are strength, positiveness and noiseless action. The steam-valve motion is continuous. No tappets are used in the valve gear, and there is no pause in the motion of the auxiliary valve except at the moment the main piston is reversing its motion; the result being a smooth, noiseless action. The pump piston is packed with brass expanding rings. The valves are of brass with flat faces. It will take water from a heater and deliver it into a boiler at a temperature of 212°.

The Distillers beer pump is the result of many years experience. Every part of the pump end is of copper and the composition to resist the action of the acid in the liquid. The suction pipe is provided with a hand-hole plate which is held in position by lever nuts. By relaxing these nuts the plate can be swung out of the way so that the arm can be inserted through hand-hole for the purpose of cleaning out the pump. This can be done without wasting beer on the floor, thus preventing the house from getting filthy and sour, especially in hot weather. The pump is also adapted to pumping any thick fluid containing acids that attack iron.

The vertical pump is for pumping from deep wells or mines. The steam cylinder is placed upon the floor, above the well, or shaft so that it is unnecessary to go below to start the pump or lubricate the parts. The pump is double-acting and therefore throws a continuous stream. It is fastened to cross-timbers in the well, and is connected with the frame of the steam cylinder by two vertical rods. It works perfectlyeven when the pump is placed 100 feet below the steam cylinder. These pumps will work without shock or jar, as the amount of steam for the downward or upward stroke, can be governed by the engineer. There being adjustable valves at both ends of the steam cylinder, a perfectly uniform motion is produced, without regard to the weight of the reciprocating parts. The dimensions of these pumps depend on the height the water has to be forced, and other varying conditions.



NEW BOILER FEEDER.



DISTILLERS' BEER PUMP.

The Corinth Canal.

The last information regarding the canal at the Isthmus of Corinth is as follows:—The works connected with the cutting through of the Isthmus of Corinth will now enter upon a new phase. The two large dredges, *Isthmia* and *Poseidon*, are now quite ready. The changes required in order that they should work properly are about being completed, for when the ordering of these colossal machines was undertaken, only the quality of the soil as at first excavated was taken into consideration; but when, subsequently, it was found that at greater depths the soil varied in quality, new and important alterations to the dredges were necessary, and this has caused the delay in commencing work with them.

The *Poseidon* well commenced work on the Corinth side of the Isthmus about the end of January, and the *Istamia* about a fortnight later on the Calamati side. Each of the enormous dredges (the largest existing in the world at this moment) (?) is of 300 horse-power. The main chain has 24 buckets attached to it, each of a capacity of 750 lbs., so that on favorable soil each-dredge can extract 500 cubic métres of mud per hour. We think, however, that, taking into consideration the variety of the subsoil on the Isthmus, each dredge is not likely to extract more than 400 cubic metres; this added to what will be dug daily from the surface by other machines. This result will of course not be obtained until the machines are throughly understood and in full working order; but it is nevertheless evident that the cutting through of the Isthmus of Corinth will be carried out within the specified time (three years more). Four steam tugs of various sizes will also be working in conjuntion with the dredges. The engineers of the company have lately been engaged in experimentalizing on various rocks by hydraulic pressure in order to ascertain whether by this method they would be able to remove the larger blocks. An engine of 50 horse-power and the requisite pumps drive the water from the sea to a distance of 600 metres into iron cylinders, whence it is distributed under a pressure of 10 kilos, to the various pipes by which the soil is searched. Up to this time no such trial has been made in Europe. On this account these trials at Corinth are of great interest.—*London Architect.*

Steel Numbers.

In lieu of any really definite name for the different qualities of iron which are called "steel" in popular parlance, manufacturers have adopted a system of numbering that gives some notion of the condition of the product by designating the relative amount of carbon that the converted iron has received.

Soft and low steels are known from 0.10 to 0.76 of carbon; the lower grades are merely purified iron, with none of the qualities of crucible steel they weld without flux, work soft at high heats, are not burned when approach the welding heat, and are affected by sudden chilling in a cold bath only as iron would be. As the numbers approach a full per cent of carbon, the steel begins to act like crucible steel; requires a flux for weld, chills and hardens in water, and is capable of being tempered and of receiving a cutting edge. This method of designation is much better than the loose naming of the differing grades "iron" and "steel."

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TABLE OF CONTENTS

	PAGE
Recent Progress in the Public Supply of Hydraulic Power (*Illustrated*)	321
Treatment of Wood for Street Pavements (*Illustrated*)	322
Phosphor and Maganese Bronzes	325
A New Process for Hardening Plaster	325
The Hall System of Subaqueous Tunneling (*Illustrated*)	326
Erection of a Concrete Bridge in one Day	326
New Pump Designs (*Illustrated*)	327
The Corinth Canal	327
Steel Numbers	327
Editorial Notes	328
Engineering Societies in the United States	328
The New England Meteorological Society	329
The use of Coal-Cinders in Construction	328
Lift Bridge over a Canal	329
Krupp's Great Iron Works	329
Japanese Engineers	328
Parson's "Turnouts."	328
The Asphalte Roadways of Berlin	329
Personals	330
The Engineers' Club of St. Louis	331
Missouri Association of Surveyors and Civil Engineers	331
Correspondence	331
The Institution of Civil Engineers	332
Track (*Illustrated*)	333
Literature	334
Water	334
News of the Week	334
Contracting	335
Index to Periodicals	336
Market Report	336

IN these dull times, when so many good and competent engineers are out of employment, we would call especial attention to the request of "Water Pipe" in our advertising columns. A desirable position is there open to the man who can furnish the experience and business ability required. All communication must be direct with the advertiser.

LIEUT. EUGENE GRIFFIN, U. S. Engineers, in his late paper before the Military Service Institute, on our sea-coast defenses, touches the marrow of the subject when he tells, with truth, that eight well directed shells from an enemies ship, lying off Governor's Island, could destroy eight buildings in New York worth $12,000,000.

We have depended about long enough upon sentiment to protect our seaport cities and their wealth; and we fear, if put to the test, this sentiment would prove but a flimsy bulwark against the guns and ships that even a third-rate power might bring against us. From the standpoint of economy, our position is again a false one; for, as Lieut. Griffin remarks, $100,000,000 would be a comparatively small ransom to be demanded by a hostile for the safety of New York alone.

The building of adequate protective works is a labor of years, not weeks; and the making of guns to arm them would require years of labor as well. We would be the last to advise any unwise haste in the matter of preparation, but a little more activity on the part of the officials delegated to investigate this subject; and above all a supply of Government money to commence actual work, would seem to be more in the line of modern methods than the 'trust-to-luck' policy that now prevails.

THE Engineers of Paris are fertile and studious in elaborating schemes for Metropolitan railroads. They recognize that their highly organized omnibus system and plentiful cheap cabs are not adequate for the needs of a great city. Mr. Julius Garnier has brought forward a careful study for a system of elevated roads. The routes proposed are substantially those of the commission of 1872, having a total length of about 17 miles. The cost, including equipment and interest account during construction, is placed at 50,000,000 francs.

The designs of M. Garnier are closely copied after the New York Elevated roads, modified by the French instinct for beauty and order. He proposes a metallic viaduct of simple triangular trusses, carried on iron or masonry piers, according to circumstances. He suggests some variations from the New York practice worth considering. He would place one track above the other, thus obstructing the streets as little as possible, trains to pass from one track to the other by a spiral. By this disposition passengers may enter the train from one side and leave it on the other. To further facilitate getting on and off the train, it is proposed to put between each two cars an open platform car, 18 feet long, with guard rail and commodious gates. As a train nears a station passengers who wish to get off there pass to the platform car, and when the gates are opened they pass off at their own side while passengers getting on enter from the other side and take their seats at leisure. The notion is attractive to one familiar with the evening crushes on our own elevated roads. Its perfect operation however involves the French method of allowing only as many to enter a train as can be seated. The free and independent North American would insist on filling the platform cars to impossibility. M. Garnier recommends the long American car with swinging trucks and American paper wheels. It may be worth while for our paper car wheel makers to watch this enterprise.

Engineering Societies in the United States.

We are induced by a query put to us by a correspondent, to ask our readers to help us out in a complete list of all societies in the United States which properly come under the head of "civil engineering associations."

We append to this a list of those of which we now have personal knowledge, and ask that it be corrected or added to, as the occasion may require:

The American Society of Civil Engineers, New York City; instituted November 5, 1852. John Bogart, secretary.

Boston Society of Civil Engineers, Boston. Mass.

Engineers' Club of St. Louis, St. Louis, Mo.

Philadelphia Engineers' Club, Phila., Pa.

Western Society of Engineers, Chicago, Ill.

Civil Engineers' Club of Cleveland, Cleveland, Ohio.

Engineers' Club of Minnesota, Minneapolis, Minn.

Civil Engineers' Society of St. Paul, St. Paul, Minn.

Technical Society of the Pacific Coast, San Francisco, Cal.

Connecticut Association of Civil Engineers and Surveyors, New Haven, Conn.

Missouri Association of Surveyors and Civil Engineers, Columbia, Mo.

Engineers' Society of Western Pennsylvania, Pittsburgh, Pa.

Nebraska Association of Engineers and Surveyors, Lincoln, Neb.

Indiana Association of County Surveyors and Civil Engineers, Remington, Ind.

Michigan Engineering Society, Lansing, Mich.

Denver Society of Civil Engineers, Denver, Colorado.

Ohio Society of Surveyors and Civil Engineers, Urbana, Ohio.

Japanese Engineers.

Through the kindness of Professor J. A. L. Waddell, of Tokio, Japan, we are in receipt of a list of some 140 Japanese Engineers who have received an English education.

The list itself is a formidable document, and with all due respect to the gentlemen who figure thereon, we must rather congratulate ourselves that our correspondence with them is limited. We should want abundant leisure to address an epistle to a friend who, for example, required the following to indicate his titles and residence—at least we suppose that is what this alphabetical pot-pourri means:—

Y. Itsuka, Tsutsumigami, Jikakyoriokusha, Nakanomachimura, Toyadagori, Shizuokaken.

Parson's "Turnouts."

The above title is not generally intended to convey the idea which assumed form in the brain of at least one somewhat obtuse and imaginative correspondent; it is *not* a rig for the purpose of conveying the body clerical.

But it is a book that should be in the hands of every roadmaster and official connected with the placing and care of railroad track, and its turnouts. This is especially true at this season of the year, when this class of work is one of the things that must be attended to on every railway in the land.

The book itself is handy in form, low in price, and has attracted well merited attention from railroad men for the value of its teaching and the practical manner in which the views of its author are expressed. As showing how this little treatise on "Turnouts" is making its way around the world, we can mention that the last order coming to this office for it, is dated East Indian Railway, Inspector's Office, Jamalpur, India.

The Use of Coal-Cinders in Construction.

M. A. Louvier, an architect of Lyons, France, has sent a communication to the *Société Centrale des Architectes* giving the result of some experiments upon the use of coal-cinders in construction.

The idea took its origin in the attempt by the contractors about Lyons to substitute this waste product of coal for beaten earth in their works. As they were not able to solidy it sufficiently by simply ramming they mixed with it a little slacked lime. This was found to work very well and arches were tried made of this material; the agglomeration took place rapidly and this masonry, if you can so call it, presented enough cohesion to allow the uncentering of the arches within one month.

At the time the trial was made the cinder was so abundant about the various work-shops of Lyons that the cost of this construction was only about 1 franc per cubic *metre* in place; but soon after, including transportation, plant and labor, it cost about 5 francs for the same volume.

At the present time, after 13 years trial, this method of construction has so expanded in places where economy is required, that the cinder of Lyons is about exhausted and the distance from which the material is brought has raised the price to the neighbourhood of 11 francs per cubic *metre*.

In using this coal cinder in the foundation of work shops, ware-houses, etc., the usual proportion is four parts of the cinder to one part of lime. At first an ordinary fat lime was used, but this has been replaced by hydraulic lime. But if a still greater resistance is required, the proportion of lime is increased or hydraulic cement is used.

In building up a wall, the material is applied in beds about 6 inches in depth, and well rammed. The walls are usually about 20 inches thick; but partition walls, from 6 to 8

inches thick can be made either by ramming it between plank formers, or by making it into the form of hollow bricks or flagging and then putting these together with plaster or cement.

Arches in this material are made like those in beton; the only care required being to ram it tangentially and not perpendicular to the extrados of the arch; the latter action causes a tremor in the centering which has a bad effect upon the solidification of the material. The thickness of the arch will be in direct proportion to the weight to be carried; the mean depth is from 14 to 16 inches at the key for a span of 16 feet; the haunches are made at the same time and of the same material as the arches.

This class of masonry, for a long time only used in structures of little importance, has within the last two or three years, been adopted by the Lyons architects in works of greater pretentions; and M. Louvier has lately built with it almost the whole of the vaulting in the ground-floor of the new *Hotel de Préfecture* at Lyons. He had previously made some careful experiments and gives the following as the result:—The experimental arch had a span of 20.6 feet and a rise of only 4 feet, and rested upon low stone masonry abutment walls, with its shoulders abutting against the solid earth. The arch had a thickness of 1.47 feet at the key, 2.5 feet horizontal width at the springing line, and 2.95 feet vertical depth over the extreme ends of the springing line. A distributed load of 500 pounds per square foot was placed upon this arch within about three weeks after its completion, and after fifteen days application no fissure or injury of any kind was apparent. The load was then removed and a block of stone weighing 1,220 pounds was allowed to fall upon the crown from a height of 3.3 feet without the shock producing any disintegration in the arch.

Fears having been advanced that fire would have an injurious effect upon this semi-combustible material, an iron plate was placed under the key of the arch and under this a forge, by means of which the plate was kept at a white heat for half-an-hour; the cinder masonry showed no signs of being calcined beyond a very thin skin and the resistance to the load remained the same. In the destruction by fire of the Celestins Theatre at Lyons, all the work in which the cinder-masonry had been used remained intact, and it was used again in the reconstruction of the building. The relative lightness of this masonry is also an advantage, as it weighs only about 77 pounds per cubic foot.

Lift-Bridge Over a Canal.

La Genie Civile, of May 2nd, contains an illustrated description of a novel lift-bridge over the Ourcy canal in Paris, designed and built in 1868 by M. Mantion, Chief Engineer of the *Ceinture* railway. It is intended for a railway used in transporting cattle to the abattoirs at La Villette.

The difference between the elevation of the top of rail and the surface of water in the canal was only about 14 inches; hence a vertical-lift, or a swing-bridge, was absolutely necessary; the first-named type was adopted, as room was lacking for the pivot machinery otherwise required.

The width of the canal was about 27 feet, and the clear head-room allowed was 16.4 feet. The plan of support for the lift-bridge used was as follows: Two brick arches were sprung across the canal, and located 27.9 feet apart in the clear; these arches had a span of 66.6 feet, a radius of 43.13 feet and a clear rise above the surface of water of 22.15 feet. Each arch ring had a depth of 3.44 feet and a width of 6.58 feet, with brick abutments running off at a tangent to the center of the semi-arch and surmounted by steps, giving access to the crown of the arch. Two brick pillars, one at either end of the arch, supporting the ends of two plate girders carrying the rollers and sheaves for the counter-weights of the platform.

The four counterweights are made up of disks of cast-iron weighing altogether 44,000 pounds, and each of the four chains is prolonged under its corresponding counterweight by a chain of the same weight called a compensating chain. The sheaves carrying the chains, two to each chain, are 4 feet in diameter, and are provided on their circumference with depressions for the links so as to prevent slipping; the inner sheaves are connected by appropriate gearing to a hand-power apparatus for handling the platform; each side of the bridge has an independent lift, two men being required to handle it.

The lift-bridge itself, is a simple arrangement of plates and beams, suspended at the four corners, and guided into its seat by inclined surfaces at the ends and on each side. To assist the workmen in handling it, this platform contains two water tanks which are filled by pipes when the platform is up and by their weight assist the descent; as soon as the bridge is in position these tanks are emptied automatically.

The weight of the movable platform is about 44,000 lbs., and it is kept raised unless required for the passage of a train; iron gates cross the track at each end of the arch. The author says that steam might be advantageously employed, as at the similar bridge at Syracuse, New York, in this country; but, as its use is not very frequent or regular, hand-power has been found sufficient.

The New England Meteorological Society.

The third regular meeting of the above society was held in Boston, on April 21st; and twenty-six members were elected, and papers read by Prof. C. S. Cook on the "Rain-band Spectroscope;" "Atmospheric Electricity," with experiments, by A. G. McAdie, and on "Some of our March Winds," by Prof. W. H. Niles.

The Council of the Society has decided to undertake a special study of thunder-storms during the summer of 1885. A special series of circulars has been prepared, explaining the details of the work, which requires for its successful prosecution a large number of observers. Friends of the Society can render material aid, not only by making observations themselves, but by trying to secure additional special observers. Several classes of observations will be instituted; the simplest require no instruments, and can easily be made by school-children as well as by adults. It is not necessary that all the observations should be made in one place; they will be of value wherever taken. This work will be in charge of the secretary, from whom instructions and record blanks can be obtained. Address W. M. Davis, Secretary N. E. Meteorological Society, Cambridge, Mass.

Satisfactory progress has been made in the work of inaugurating the display of weather signals in New England. In Connecticut the flags are already regularly displayed in fifteen towns. A special telegram is received daily from Washington, giving the indications for the state, which are transmitted to the towns by the Standard Time Company. Correspondence relative to weather warnings in Connecticut should be addressed to J. H. Sherman, United States Signal Office, New Haven, Conn. Correspondence relative to similar warnings in other States should be addressed to the Secretary, Cambridge, Mass.

The *Bulletin*, No. 6, of the Society, gives the summary of meteorological conditions for April, based upon reports from 108 observers, with their observations given in a table, and from the current publications of the U. S. Signal Service; other interesting tables accompanying the *Bulletin*.

Krupp's Great Iron Works.

The great iron and cannon founding establishment of Herr Krupp at Essen is constantly enlarging its space and personnel. In 1860 it contained but 1,764 workmen and this number had increased by 1870 to 7,084 while at the present time it is over 20,000: if also the women and children dependent on the establishment are included, a population of no less than 65,381 is gathered together, of which 29,000 persons are actually living in houses belonging to the works.

The various departments of the Krupp undertaking are eight in number, and embrace the workshops at Essen, three collieries at Essen and Bochum, 547 iron mines in Germany, mines in the north of Spain (in the neighborhood of Bilbao), the smelting furnaces a trial ground of 17 kilometres at Meppen for proving cannon, together with others at different places with an area of 7½ kilometres. There are 11 smelting furnaces, 1,542 puddling and heating furnaces, 439 steam boilers, and 450 steam engines of 185,000 horse power.

At Essen alone the works connected with rolling stock comprise 59 kilometres of rails, 28 locomotives, 883 wagons, 69 horses, 191 trolleys, 65 kilometres of telegraph line, 35 telegraphic stations, and 55 Morse apparatus.—*London Times*.

The Asphalte Roadways of Berlin.

Translated for Engineering News.

In the *Mèmoires de la Société des Ingènieurs Civils*, for February, 1885, is a lengthy and valuable paper, by M. Leon Malo, upon the Asphalte Roadways of Berlin; we make from it the following abstracts:—

He first refers to the enormous vehicle traffic over certain of the streets of Paris, stating that on the new avenue *de l' Opera*, the official returns show a daily passage of 35,000 carriages, and at the intersection of the *rue de Rivoli* and *du Louvre*, the figures reached a total of 42,000 in 24 hours. The paving material proper for resisting this torrent of travel which menaces the very existence of the streets of great cities is worthy of the most serious consideration.

In referring to Berlin, which he had lately visited, M. Malo said that he had discovered nothing absolutely new, as the majority of the paving methods adopted on the banks of the Spree were practically the same as those employed on the Seine and the Thames. But in adopting these plans, the authorities of Berlin had used so much care and method, and had studied the problem so conscientiously that their plans can almost be regarded as innovations, and their practice can be studied with profit.

To commence with some statistics:—In 1876, when the care of the streets of Berlin passed into the hands of the State, there were 3,730,000 square metres of public way, viz: 12,000 square metres of stone block paving simply laid on sand, but nevertheless very well preserved; 3,348 square metres of block paving, very badly demoralized by traffic and in a condition literally frightful; 360,000 square metres macadamized pavement and 10,000 aquare metres of *asphalte comprimè*.

At the present time there are; 375,000 square metres of stone block paving laid upon a very solid foundation, with joints of sand and bitumen: 545,000 square metres of stone block laid upon a simple bed of sand and gravel, in the least used streets and in good order; 3,088,000 square metres of very defective stone paving, laid in quarters where the work of sewers, pipe-laying, etc., below the street surface is not yet executed, and intended to be relaid; 483,000 square metres of macadam; 320,000

square metres of *asphalte comprimè* and 40,000 square metres of wood pavement.

M. Rospatt is the engineer in charge of this improvement of the roadways of Berlin, and M. Gotheiner is his able assistant. In regard to the material used andthe practice of laying, and M. Malo speaks as follows:—

The ordinary paving stones are of Swedish granite (Karlskrona), excepting some thousands of square metres laid with porphyry from Belgium. The stone is delivered ready for use, and the Swedish granite is from 0.19 to 0.20m (7.45 to 7.87 inches) in thickness; the Belgian stone has a depth of from 0.15 to 0.16 m (5.9 to 6.3 inches).

In laying this stone the method is as follows: Upon the prepared ground is first spread a 4-inches bed of broken granite,then a second 4-inches of still finer granite; this layer of nearly 8 inches of broken stone is then firmly compressed by means of a steam-roller of 15 tons weight; after which it receives a further covering of a little more than an inch of gravel. On this foundation the paving stones are set dry; with joints about one-half inch (10 to 12 millemetres) apart, which are filled up halfway with fine gravel and the remainder of the voids filled with a mixture of pitch and creosote (*de poix et de crèosote*). This is exactly the system adopted in paving the principal streets of Liverpool. Under the tramway lines, whether the streets are paved with stone, asphalte or wood, the foundation is always laid in cement beton.

The paving stone used in Berlin is divided into three distinct classes: the first, reserved for streets definitely finished, is a perfect parallelipipedon; in the second class,the lower surface of the stone is equal to ⅔ that of the upper surface, in the third the stone is laid in two tiers. When newly opened streets are to be paved, a provisional pavement is laid down of the second or third class, placed upon an 8-inch bed of ordinary gravel. This is replaced by the first-class pavement when all the underground work of sewers, water and gas mains, etc., is finally completed. This is a system of precedure very unlike the usual practice in other cities.

Stone pavement laid on a beton foundation meets with little sympathy in Berlin; it is noisy,and the engineers doubt its durability.

The first serious trial of wood-pavement was made in Berlin in 1879. At this period the roadway of one of their most elegant streets, the *rue de l'Opera*, was laid by the "Improved Wood Company" This first specimen of this class of paving was replaced last summer by *asphalte comprimè*. While this wood-pavement was laid under excellent condition, on a very solid bed of cement beton, and in a street of light traffic, it was muddy and bad at the end of five years. The wooden blocks had become rotten and worn away in such an irregular manner that vehicles had ceased to pass through the street.

In the construction of this pavement blocks of Swedish pine had been used. Different companies have tried other woods variously treated; Bohemian pine injected with creosote, pitch-pine, yellow-pine, and cypress with or without injection. The wood pavement still remaining as examples of these various experiments is still too new to furnish any conclusive data. One objection made is to the escape of the creosote from the freely injected blocks under the climate of Brandebourg, where the heat of July is as violent as the cold of winter is rigorous. During the summer months the air of the city was impregnated with the fumes of creosote and a popular outcry arose against this unfortunate pavement.

The asphalte pavement has had a more happy fate. Four different kinds are used on the streets of Berlin; Val-de Travers, Seyssel, Ragusa (Sicily), and Limmer (Hanover). The asphalte of the Val-de Travers, the first introduced and as a consequence the most used in the city, presents during the great heat of summer, the same propensity manifested in Paris before the idea of mixing it with Seyssel asphalte took form;* that is some softening under the wheels of vehicles and the formation of waves, which promptly dissappeared with the return of cooler weather. At Berlin, where the mixture mentioned is not used, these waves are produced each summer with a certain persistance; but as they have caused no sensible degradation of the roadway the public and the engineers are little predjudiced thereby.

The Ragusa asphalte presents the same characteristics. As to the Seyssel asphalte, the slight percentage of bitumen in it preserves it completely. Though more troublesome to put into the work than the other two because of its relative meagreness, this very difficulty requires the more careful management in its application, and, in heating it particularly, the greatest regularity. But, put down under these conditions, it makes a roadbed superior to the others, on account of its exemption from waves and the softening propensity found in the products of an asphalte too rich in bitumen.

The fact should be recognized that the success of *asphalte comprimè* in Berlin is greatly due to the extreme care with which the preparation of the beton bed is conducted and supervised. This beton is from 0.20 to 0.22m (7.9 to 8.6 inches) in thickness and forms an unvarying solid base. M. Malo saw a bed of this beton being demolished for the laying of a tramway and he compares it to a granite monolith. In making this beton, one portion of 170 kilos. (374 lbs.) of Portland Cement of the best brand is used with one cubic metre (35.3 cu.ft.) of what the Germans call "ballast;" that is, a mixture of pebbles and a kind of equally divided sand, as to size, found in the old dunes surrounding Berlin. The asphalte is never applied until the beton is compressed and perfectly dry; in this way the production of the vapor is avoided which would otherwise follow the spreading of the asphalte powder, heated to 120° to 130° C, over a humid surface; a vapor which in its escape will cut up the asphalte crust and destroy its homogeneity. Much of the original trouble in Paris, during the first applications of *asphalte comprimè*, had its origin in the neglect of this rule, which the Germans have made an absolute rule and respect with the greatest care. They believe it is preferable to obstruct the street for fifteen days or more, and in the end feel assured that the roadway before their doors will never after need repairs.

In conclusion, M. Malo says that he feels justified in drawing the conclusion that both asphalte and wood pavement should exist in Paris without one enroaching upon the domain of the other. These two systems of pavement have a common quality, that of offering to the wheels of vehicles a smooth and relatively elastic surface; but their personal properties are perfectly determined and can be differently utilized. Both have their place marked out and it would be an economic error to throw aside either of them.

Without putting their respective merits into the balance, M. Malo says, that he must insist upon remarking that if wood pavement is a complication in public hygiene, the asphalte is an auxillary in the question of public health Wood, he thinks, belongs to the wider streets and great boulevards, where the air circulates freely, sweeps out the miasma and drys the soil. In such places the special inconveniences of a wood pavement are certainly balanced by its advantages. But it should never be used in narrow streets with little sunlight. The streets still paved with the old-time sand stone are even now the accumulators of dampness and of evil odors, which, in a city as densely populated as in Paris, can not but have a deplorable effect upon the public health. This being now the case, the effect can better be imagined than described of replaced this old pavement with that immense sponge called a wood pavement.

In referring to the ill-luck attending the use of wood pavement in America, M. Malo says that the Americans have not used the material with the minute and extreme care which the Germans and French have given to their street paving; if the American pavements have rotted out in a few years it is because the impregnating fluids were badly chosen and insufficient in effect, the bed was defective, being of insufficient thickness and the cement of inferior brands; and because, as the beton afforded no protection from the humidity of the subsoil; the wood rotted from below and above.

*The Val-de-Travers Co. now use a weathered out crop of their own rock, called *crappe*, when they find it desirable to decrease the proportion of bitumen in any desired work. This *crappe* is simply the same rock which has lost a portion of its natural bitumen by exposure to the elements.—ED. ENGINEERING NEWS.

PERSONAL.

G. M. THOMPSON, formerly of the Mexican Central, has been appointed chief engineer of the Boston & Lowell, vice I. M. Story, resigned.

F. F. HAGADORN, until last fall bridge superintendent on the Lake Erie and Western Railroad, died on May 11, at Muncie, Ind., of consumption contracted by exposure in the service of the company.

W. W. COLLINS, has been appointed assistant superintendent of the Chicago & Milwaukee division, and the Chicago & Council Bluffs division, in Illinois, of the Chicago, Milwaukie & St. Paul Railway Company, with headquarters in Chicago.

SAMUEL R. BRICK, an architect and engineer, died in Philadelphia last week, in the 74th year of his age. Mr. Brick built the Washington and Fairmount Gas-Works in Philadelphia and was for many years President of the Richmond County Gas Co., of Stapleton N. Y.

F. Y. DANBY, Chief Engineer and Superintendent of the Vicksburg, Shreveport and Pacific, has retired from those positions, that road and the Vicksburg and Meridian having been consolidated under one superintendency. Mr. Danby was urged to retain his position as Chief Engineer, but declined on account of poor health.

JOHN Rawlins of Birmingham, England, is now taking a tour in this country. Mr. Rawlins is general manager of the Metropolitan Railway Carriage Company, the largest car-building establishment in England. While in this country he proposes to visit the leading car works, and gather information which will doubtless be of value to him.

LIEUT. D. C. KINGMAN, United States Engineer Corps, who has charge of the government improvements at the Yellowstone Park, passed through St. Paul on May 15, on his way to the Park. He has a force of about sixty men now employed there, working upon the road down Gardner canon, constructing the new road between Cinnabar and the hotel, and bridging McGibbon river.

MAJ. HENRY S. MORSE has resigned as General Manager of the Brunswick and Western Road. From 1871 to 1875 he was division Superintendent of the Delaware and Hudson Canal Company's Road; subsequently he was Assistant Master of Transportation Baltimore and Ohio (Chicago division); then General Superintendent Indianapolis, Dacatur and Springfield Road; 1880 to 1882 Superintendent Construction and Operation New Orleans division New Orleans Pacific Road, and has been General Manager of the Brunswick and Western since May 1, 1883. A. A. Gaddis, General Manager of the Ogdenburg and Lake Champlain Railroad, has been appointed in his place.

NORMAN C. MUNSON, the well-known contractor, died in Boston on May 16. He was best known in connection with the filling in of the Back Bay in Boston, from which he realized enormous profits, to be afterwards absorbed in the ill-fated Hartford & Erie R. R. enterprise. He was one of the best known N. E. railroad contractors, being engaged on many important works.

THE American Institute of electrical Engineers met at the house of the American Society of Civil Engineers, May 19, and elected the following officers: President—Dr. Norvin Green; Vice-Presidents—D. H. Bates, Prof. A. E. Dolbear, Francis W. Jones. Managers—Charles L. Buckingham, David Brooks, T. C. Martin, George M. Phelps, Jr., Prof. B. F. Thomas, W. D. Sargent; Treasurer—Col. Rowland R. Hazard; Secretary—Ralph W. Pope. The report of Acting Secretary T. C. Martin shows that although the institute has only been in existence one year it has 279 members and associates in all parts of the country.

THE President has appointed, under an act of Congress, the following board to examine and report at what ports fortifications or other defenses are most urgently required, the character and kind of defenses best adapted for each, with reference to armament, and the utilization of torpedoes, mines or other defensive appliances: Hon. William C. Endicott, Secretary of War, president of the board; Brigadier General Stephen V. Benet, Chief of Ordnance; Brigadier General John Newton, Chief of Engineers; Lieutenant Colonel Henry L. Abbot, Corps of Engineers; Captain Charles S. Smith, Ordnance Department; Commander W. T. Sampson, U. S. Navy; Commander Casper F. Goodrich, U. S. Navy; Mr. Joseph Morgan, Jr., of Pennsylvania; Mr. Erastus Corning, of New York.

The Engineers' Club of St. Louis.

ST. LOUIS, May 13, 1885.

218th meeting was held at Washington University. President Moore called the Club to order at 8:20 P. M. There were 17 members and 7 visitors present. The unapproved minutes were read and adopted. The Executive Committee reported favorably on the proposal for membership of Walter S. Russell. He was ballotted for and elected. Mr. Joseph T. Monell was proposed for membership by Messrs. W. B. Potter and J. B. Johnson.

The committee to consider the status of Civil Engineers in the employ of the United States made the following report.

Engineers' Club of St. Louis.

GENTLEMEN.—Your committee to consider the status of Civil Engineers in the employ of the United States respectfully reports:

That we find the question of the relation of Civil Engineers to the public works undertaken by the General Government was one of considerable prominence in the debates in Congress, during the late session of that body, and is now in the public press. Also, that there is a general impression that the time has come for an increase in the numbers of the corps of Engineers sufficient to enable them to conduct the works under the present organization without employing civilians, or for a reorganization of that branch of the public service, by which it shall be made a distinctively civil service.

Your committee is decidedly of the opinion that the best interests of the military service, as well as those of the civil engineering profession and of the country as interested in both these, demand that the latter alternative be the one pursued.

Your committee regrets to see the discussion of the subject in the public press turning aside from the broad question of creating an organization for the conduct of public works, which shall be equitable and just in distribution of rewards for merit, in promotion to higher rank and pay; which shall recognize the change in the condition of the engineering profession, both military and civil, since the days when both had to be imported from Europe, and which shall allow its engineers to come by judicious selection, the same as judges are selected, from the ranks of a profession and not from the ranks of a single school.

To this question personal matters, past present, or future, the value of different schools and mode of training, or the honesty and truthfulness inculcated through certain associations are alike foreign.

There seems, therefore, to be need for a conservative influence, lest the utterances of individuals be taken as expressing the views and wishes of the engineering profession, and lest a discussion of a pure question of public policy degenerate into a controversy about matters of no consequence.

Other clubs than our own have taken up the consideration of the matter and have appointed committees. It has been suggested that these committees act together if possible through correspondence and conference by representations if practicable with a view to a joint memorial to express to Congress our view of the matter and a draft of the legislation required to carry that view into practical effect.

Your committee therefore asks to be continued, and for authority to confer with the representatives of other Engineer Societies, Clubs or Associations with a view to concert of action, but without power to pledge this club to anything.

Respectfully,
ROBERT E. MCMATH,
J. B. JOHNSON,
H. S. PRITCHETT,
J. A. OCKERSON,
Committee.

By vote of the Club the committee was continued and the authority asked was granted.

Mr. Frank H. Pond read a paper on "Pumping Machinery and Water Works." He reviewed the methods of procuring water, from the days of running streams and wells, which developed into the grand aqueducts of Rome, to the use of water pipes for introducing water into dwellings, first employed in London in 1582. Cast-iron came into use for making water pipes in 1810. The oldest water works in the country are supposed to be those built at Bethlehem, Pa., in 1754. Now, in 1885, there are 1,040 water-works in the country, of which 355 are supplied by gravity, 649 by pumping, and 36 by unknown methods. Then followed an extensive treatise, illustrated by tables, in which the conditions, works and requirements of the modern pump were thoroughly explained. The main points treated of were the pump employing crank motion and heavy fly-wheel, and the duplex pumping engine.

The paper was discussed by Messrs. Moore, Johnson, McMath and Seddon. Adjourned.

THOS. D. MILLER, *Secretary.*

Missouri Association of Surveyors and Civil Engineers.

The fifth annual meeting of the above association will be held in the Engineering Department of the Missouri University, at Columbia, Mo.; commencing on June 24.

The following is a list of the papers to be presented:

"Old Corners of County Surveyors,—what weight shall attach to them," S. J. Carter; "Public Water Supply, and Water-works," Henri Chomeau; "Standard Measures," B. F. Thomas; "The Railroad," Geo. C. Pratt; "The French Water-level," J. H. Stowe; "Iron Bridge Connections," J. W. Hoover; "Reclaiming Swamp Lands," G. W. Steel; "Foundations for Highway Bridge Piers," Thos. C. Wilson; "Dirt Roads," M. G. Quinn; "Sanitary Engineering—How shall we prepare for the Cholera?" Paul Schweitzer; "Graphical Methods of determining Strains in Bridge Trusses," J. J. Sanders; "Mine Surveying," J. W. Spencer; "Magnetic Declination, its peculiarities," T. H. Halley; "Relative Resistance of different forms of Bridge Piers," Joseph Ficklin; "Masonry for County Road Work," J. A. Swetnam; "Variation or Declination at different points in Mo.," J. Y. Powell; "Section 6," J. Eckert; "Wagon Tires—their widths," R. H. Phillips; "Engineering Instruments, and their use." C. D. Rodgers; "Sewers for Towns," Chas. H. Zoll.

W. L. Combs is President and Professsor T. G. Lowry is the Secretary of the Association. All surveyors, ex-surveyors and civil engineers are invited to attend; also the manufacturers of engineering instruments.

CORRESPONDENCE.

Pile Cutting Machine.

SPRINGFIELD, MASS., May, 13, 1885.

EDITOR ENGINEERING NEWS:—Referring to your illustration of the Cutting Machine in last issue, page 293, allow me to say that the same arrangement was designed and used by us, in putting in the foundations of the R. R. bridge, at Southampton, Mass., in the year 1873. The only difference being that the frame was made of wood instead of iron. Yours truly,

J. R. SMITH.

The Metric Reform: is it Declining?

BOSTON, May, 19, 1885.

EDITOR ENGINEERING NEWS:—The Metric Reform seems to have experienced an enormous "shrinkage in its assets." A half dozen years ago it published officially a table to show "the extent to which the metric system has been actually introduced among different people"; a classification was made, rated as the introduction was, "by compulsory or permissive legislation"; and the total population of the States in which "the metric system is obligatory by law," was given as 487,825,232. Such minute accuracy to the units place evinces the painstaking conscientiousness with which the investigation was made.

But, as your editorial of May 2nd, announces, it appears from the statement of the librarian of the Geographical Society of Paris, that "the use of the metric system is now required by law in countries having a total population of 242,000,000" only.

Certainly "a reaction seems to have set in," as you say. If the reaction continues as fast, it will be but a short time before the minions of the law will have nothing but a minus quantity upon which to enforce the "compulsory use." ALBERT H. HOWLAND.

Our London Letter.

LONDON, April 27, to May 3, 1885.

EDITOR ENGINEERING NEWS:—After a passage of ten stormy days, fortunately unaccompanied with any "uprising" or rebellious symptoms in our stomachic organization, friend Wiley and ourselves landed on British soil at Liverpool.

The first noticeable feature was the extreme order observed in all things; police abound, politely answer all questions and keep everything moving smoothly about them. The streets are, to a New Yorker, phenomenally clean, in the lanes and by-ways as well as in the main thorough-fares. We have very few if any such street pavements in America as are in general use here, and boys in red shirts swarm over them, sweeping up the least particle of objectionable matter as it is deposited. The sweeping and watering is so systematically conducted that there is absolutely no dirt and no dust.

The main streets of the West End of London are almost entirely free from traffic, or the transport of merchandise, and you will see more heavy hauling on Broadway in one hour, than you could see in a week on Oxford or Regent Streets, or on the Strand. But the passenger vehicles more than make up for the first named deficiency; thousands of hansoms and long processions of omnibuses are required to move about the never-ending swarms of busy Londoners. The top of the "bus" is the favorite spot for the traveller, and it is "Coaching" on an enormous scale. But after the brisk driving over the smooth wood and asphalt pavements of London, the contrast is strong with the lumbering coaches and horrible roadway of our own Broadway. The fare here varies with the distance at the rate of about one penny per mile. Of street-car lines, or "tramways" as they call them, we have as yet seen but one, somewhere in the vicinity of Hyde Park.

In coming from Liverpool, we rode "third class," one penny per mile, and found the compartment comfortable, seats well upholstered and the outfit more clean than the average first-class car on the, say, New York Central R. R. Railway travel does not seem to be so universal here as in the United States; there are no emigrants and the visiting instinct does not seem to be as strongly developed as with the Yankee.

Checking baggage, "on the American plan," is now in use on the London & Northwestern railway; we paid the equivalent of 50 cents per package for the carriage from Liverpool to our hotel in London; *both* "brasses" were attached to the trunk and we were furnished with a written receipt. But the Englishman has not yet "absorbed" the full idea of baggage-checking, and little inconveniences are yet liable to occur. We placed our valises on a truck with directions to leave them at Chester; two of them were left as directed, and the

other turned up at Birmingham, to be sent on to London three days later. However, this particular straying of baggage was mainly our own fault, for if ordinary care is taken to label and properly direct packages they will usually be found where wanted. While the English practice seems a little "loose" to Americans, it is really less troublesome than it seems, thanks to the number of employees at each station and their experience.

The difference between a city of about two million inhabitants and one of four millions is very great and it takes time to get fairly well accustomed to the new situation. Then, too, the entire absence of all regularity in the plan of London, its innumerable lanes, courts, roads and alleys, the change in the name of different portions of continuous streets, and the trick of numbering houses consecutively down one side of the street and up the other, render the policeman an absolute necessity to the stranger. But "getting lost" is, after all, rather pleasant than otherwise, where there are so many interesting objects to see and note, and the omnipresent hansom can always help you out.

The cost of living in London is about the same as in New York, the outlay depending entirely upon the taste and means of the individual. The recent dynamite explosions have interfered materially with sight-seeing in certain parts of the Metropolis, and when admission can be gained to a public building policemen and detectives abound; these scan the stranger with a suspicious eye, and seem to be weighing the possibility of a few pounds of the dreaded explosive and a bit of "Yankee clockwork" being somewhere concealed about said strangers' clothing. Notice is given by placard that "any person or parcel is liable to search," and if a man's overcoat pockets seem to be unusually well filled, he is liable to hear from the police. The smallest satchel is not allowed to pass into a picture gallery or public building; and there is absolutely no admission to the Parliament buildings, except to the House of Commons on a Members' order; and no one can pass even the outer gate of the Tower.

The Institution of Civil Engineers is a very important factor in London life and it weilds an influence inconceivable to Americans. The headquarters of the Institution are at 25 Great George Street, in the court end of the Metropolis, and almost within the shadows of the Parliament building and Westminster Abbey. It has a fine building and a handsome library, but admission to the rooms is only to be had through introduction by a member, or by permission of the secretary. Meetings are held weekly during the session; they are well attended and the discussion of papers is very general. The Annual Dinner of the Institution of April 29th, shows the English appreciation of civil engineers; it was an elegant affair, attended by men whose fame is world-wide and represented in the social world by the Dukes of Edinburgh and Cambridge; but as your readers have doubtless heard all about the dinner we will not take up space by describing it.

Sir Frederick Bramwell, the President of the Institution, has a large income as a civil engineer, but was knighted, we understand, for solving a problem connected with the bursting of a certain big gun. But the presiding genius of the place is Mr. James Forrest, the widely known Secretary of the Institution. He is a man of middle age, a first-class civil engineer himself, and a born organizer; the able manner in which he has for many years handled the affairs of his widely scattered constituency, is proof sufficient of his eminent fitness for the responsible position which he holds.

The hero of the hour in engineering circles is Hiram Maxim, the inventor. His machine-gun has been described in nearly all the scientific papers, and we were present at the meeting of the Institution of Mechanical Engineers when he read his paper on that subject, and again a few days ago when he exhibited his gun to Mr. Gladstone, the Premier, and to Herbert Gladstone, Hobart Pasha and many members of Parliament and army andnavy officials. Mr. Maxim is certainly the other inventor of a fearfully effective weapon of war, but it remains to be seen whether he will be any more successful in disposing of it to the Government than that inventor, Mr. Longridge, of wire-gun fame, who, at the meeting mentioned spoke in commendation of the machine and closed with the remark that "I hope the inventor will succeed as he deserves. *I* have found it very difficult."

We attended the Annual Dinner of the Institution of Mechanical Engineers, given at the "Criterion," the most noted engineer present being Sir James Douglas of Eddystone Lighhtouse fame. It is difficult in this day of rapid and constant travel to go anywhere about this earth without meeting someone you have met somewhere before. We have had this experience and the pleasure of encountering some old friends. Among these was Mr. Robert Gordon, who will be pleasantly remembered by the members of the American Society of Civil Engineers, who became acquainted with him at the Buffalo Convention and at other points. Mr. Gordon, after twenty years service in the Government employ as Superintendent of Public Works in the Province of Burmah, has now retired upon his pension. His late visit to America was for the purpose of investigating and reporting upon the general engineering and railway practice of that county. We believe he now proposes to form a company, with offices in London and Bombay, for the purpose of introducing American methods and American tools and appliances into India, for which purpose he thinks they are particularly well adapted. His agent in New York is John A. Gifford, No. 17 Park Place; and we believe Mr. Gordon would be glad to correspond with Americans whose interests lie in that direction. The opportunity presented for the introduction of American machiney into the Indian market is too good to be neglected, and as an American we highly approve of the enterprise.

Very truly.
G. H. F.

The Institution of Civil Engineers.

Sir Frederick Bramwell, the President, in replying to the toast, "The Institution of Civil Engineers," at the late Annual Dinner in London, spoke as follows:

My Lord Sudeley, your Royal Highnesses, my Lords, and Gentlemen,—I think you have heard enough of your Presidents's private history and that it is unnecessary for me to add anything to what Lord Sudeley has said on that subject. I believe that I had the advantage of not learning to read or write until rather an advanced age; but I know that I could make a steam engine before I was six years old. I know it is by some considered to be decorous to deprecate such laudatory expressions as those used by Lord Sudeley in proposing this toast, and such marks of approbation as you have been kind enough to evince, but in the eyes of persons who hold such opinions I shall be regarded as guilty of indecorum, for I am about to say boldly that those remarks and that approbation are, in respect of the profession of the engineer, deserved. Your approval, although in terms accorded to the Institution of Civil Engineers, has, in truth, been given to the profession of civil engineering, and although the definition of a civil engineer has more than once been quoted in public, I will repeat it, because I desire to use it as the foundation for a question. The civil engineer is defined to be one who employs the great sources of power in nature for the use and benefit of man. The question I wish to found upon it is this: Is there any pursuit more noble, or is there any object more laudable than that of converting these sources of power to the use and benefit of man? This definition is not a mere form of words without life or practical value, for it is in its spirit that the engineer, as each discovery is made in pure science, applies that discovery to some purpose of general utility. The ideal engineer —I am glad to say in many cases the real engineer—of the present day is one who has a scientific knowledge as the foundation for his technical training, and frequently that scientific knowledge is of a very extended character. Mechanics, it need hardly be said, are essential, but in addition, many branches of physical science, such as heat, light, sound, hydraulics, pneumatics, magnetism, electricity, are all now within the knowledge of the accomplished engineer. Moreover, although I do not suggest that every engineer should be a chemist, it is quite certain that he should not be without some chemical instruction, even if it be confined to that which is needed to warn him that the time has arrived when he should seek sound chemical advice. Consider the result of the application of some of these sciences. Take that of heat; from it we derive the steam engine, the gas engine, and other heat motors. In their absence mankind was dependent for motive power upon human or upon animal exertion, or, as a triumph of engineering, upon the mountain stream or the winds of Heaven.

These later powers are limited in extent and uncertain in supply, animal power being also costly and incommodious, and human power, as derived from turning of handles or the walking within treadwheels, a lamentable exhibition of unintelligent labor, reduced to the level of the animal—the squirrel in his cage, or the turnspit in the kitchen. The invention by the engineer of that heat motor—the steam engine—has changed all this. So long as fuel can be found, power to supply all wants in all situations exists. Thousands of horse-power are aggregated in the comparatively small space of a ship's engine room, and perform their work unrestrained and uninjured, although partaking of every motion of the storm-tossed structure that contains them. Again, it is possible to concentrate within the limited space of the torpedo boat, if not thousands of horse-power at all events hundreds of horse-power, the soul of a fabric, which for symmetry and lightners is unsurpassed, and which cleaves the water with the rapidity of an arrow. Again, on land, on our railways, the locomotive which we look upon now as a matter of course. Those who design and construct it know that even after these years of experience it requires a profound engineering knowledge to combine into one harmonious whole the component parts of the engine, so that it shall be trustworthy for the service on which it is employed. Aided by these heat motors, navigation has become a practical certainty, and to it we owe the supply of a large proportion of our food. I will not detain you by enlarging upon the advantage to progress and, I believe, to the advancement of good will among nations which inevitably follow increased communication. But, although the subject is not connected with heat moters, it is again to the engineer that under God's blessing we largely owe our home-grown food. The agricultural show of each year is in its mechanical section an embodiment of engineering skill. So much for engineering in connection with food supply.

As regards our clothihg, it is to the perfection of machines, to their careful planning and exellent execution, that it is possible to make the hundreds of reciprocations per minute and the thousands of revolutions per minute that are commonly needed for the economical production of those fabrics which constitute the greater part of our clothing. And with respect to our dwellings, it is again to the engineer that we owe the distribution of water by which the loftiest house of our towns is supplied to its top-most story, insuring cleanliness and health, and it is to him that we also owe that other essential of a healthy habitation —the removal of refuse matter. Again, to the engineers we are indebted for the laying on of light, or, to be more accurate, a source of light up to the present time by means of gas, shortly I trust—as a light of luxury at all events—by means of electricity. Thus in the three primary material wants of mankind—food, clothing and shelter—the engineers plays the important part. To go to higher matters, am I not justified in saying that education and mental culture are by the spread of intelligence all largely indebted to the engineer? How would it be possibie to have our cheap editions of works of science, of general literture, and, above all, of the Bible itself, were it not for the wondrous rapidity and accuracy of the steam-printing machine, the product of the engineer—a product which in its highest form is to be found in those machines which, by carrying out thousands of impressions an hour, satisfy the all but insatiable demands of newspaper production? Remember, too, that the application of electrical science is now employed in the telephone to transmit the record of Parliamentary debates to a compositor who by means of a machine sets the type; that distant intelligence comes from the furthest end of the world to the newspapers by the ordinary electric telegraph, and that the papers when printed are distributed by the railway throughout the country.

With respect to this very Invention Exhibition, of whose council I have the honor to be the chairman, am I not entitled to say that, except as regards certain chemical inventions, without the engineer this exibition could have had no existence? Not because my subject is exhausted, but in order not further to detain you, I will sum up by saying that the whole of the material needs of humanity and many of its intellectual requirements are either satisfied through the labors of the engineer or are under obligations to those labors. Even in the dread art of war, whether it be the construction of a 150-ton gun, every part of which owes its existence to processes devised by engineers, or whether it be the deadly rapid-firing machine gun, or—going to the other branch of the service—whether it be the war vessel, which, from keel to truck and from jibboom to taffrail, is one embodiment of engineering skill, both as regards the structure and the propelling power, the engineer may be looked upon as the defender of his country. Having regard to the foregoing considerations a mere fraction of those which I might have adduced had time permitted, I trust you will agree with me that I have not overmuch magnified the profession of the civil engineer, the center of which profession in these kingdoms is that institution to which you have wished prosperity and of which the good will of my fellow members has for this year made me the president. In that capacity I have felt bound to dilate somewhat upon the claims which the engineer has to good will, but let me say now that I have reason to thank you most heartily for the unmistakable manner in which you have manifested that good will to-night.

THE Sewage Conduit proposed for Cleveland, Ohio, will be about 8,700 feet long, circular in form and 12 feet in diameter inside. It would be from 60 to 100 feet below the surface according to an interview with City Engineer Force in the Cleveland *Leader*. The conduit and pumping machinery is estimated to cost $400,000.

ENGINEERING NEWS Three months for One Dollar.

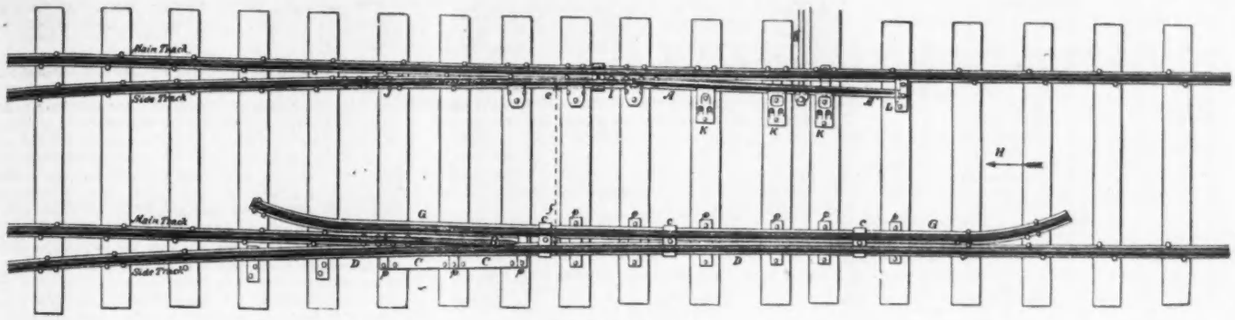

FIG 89—TRACY SWITCH.

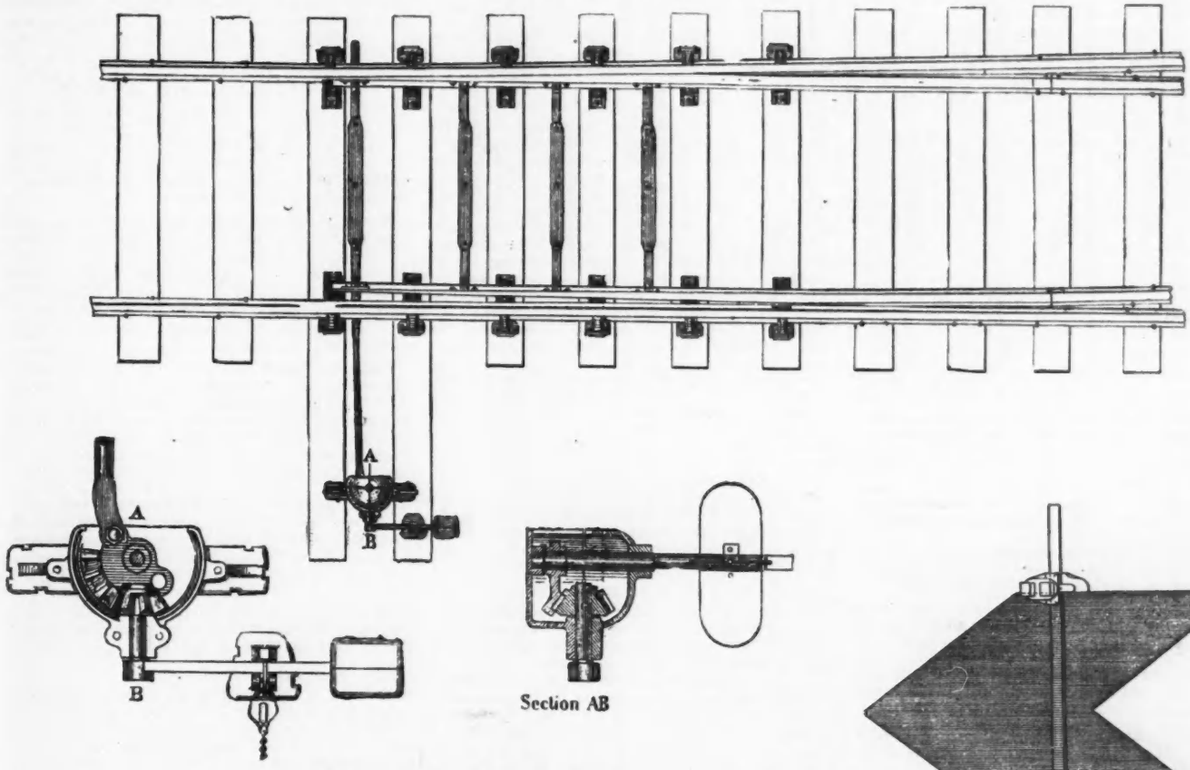

FIG. 88—PENNA. STEEL CO'S LOW STAND.

TRACK.*

BY W. B. PARSONS, JR., C. E.
ROADMASTER SUSQUEHANNA DIVISION ERIE R. R.

(*Continued from page 316*).

For use in yards where low stands are required there are several designs. Brahn makes one like his big stand which lets the points fly back, and Fig. 88 shows a simple pattern manufactured by the Pa. Steel Co., which works on the other method of being fully thrown by the first pair of wheels. It will be seen that there is no spring, the automatic throwing being accomplished by the weight flopping over, which weight also acts as the hand lever. The intermediate mechanism consists of a rack and pinion; therefore, with no spring to compress the points must be home before the weight drops down on the block. In case the switch is locked as indicated and a train attempted to pull through it when set wrong, the result would be the breaking of the weakest part, the lock latch and the weight would be free to go over. A standard with target and lamp can be added if desired.

Besides the double pointed switches, there is quite a numerous class of single pointed switches usually adopted in yards, with low numbered frogs, to save room. As probably, the best sample of these, we select the Tracy, although designed for a more ambitious field than yard work. Fig. 89 shows a plan of the switch set for the main track. It will be noticed that there is a short, moveable point *A A'* connected with the switch stand by the rod *g*. Where, with double pointed switches, there should be another point, there is now a stationary rail *B*, called a frog point. *G G* is a guard rail spiked only at the ends and fastened by the three yokes *c c c* to the spring rail. *D* also spiked only at the ends. When the switch is set right for a train pulling into or out of the siding, each pair of wheels getting a purchase on either the heel piece or moving rail, forces outward the spring and guard rails together so as to give passage room for the flanges between *D* and the frog point *B*. When the switch is misplaced, the point *A* is set right by the first pair of wheels. It will be seen that at *I*, where the heel piece and moving rail join, they are set quite close to the main rail. They thus act as a guard rail to keep wheels on the main track from striking the blunt joint of *B*. Other single pointed switches usually have a regular frog arrangement instead of a spring rail.

Fig. 90 gives view of the Tracy stand with one half of the cast-iron casing removed. It belongs to the same general class as the Snow, that is to say, it is a positive throw for both tracks. As a class, switches with single points are inferior to those with double points, the special objection to the Tracy being that it depends on the constant elasticity of two rails and relies for security on the three yokes *c c c*.

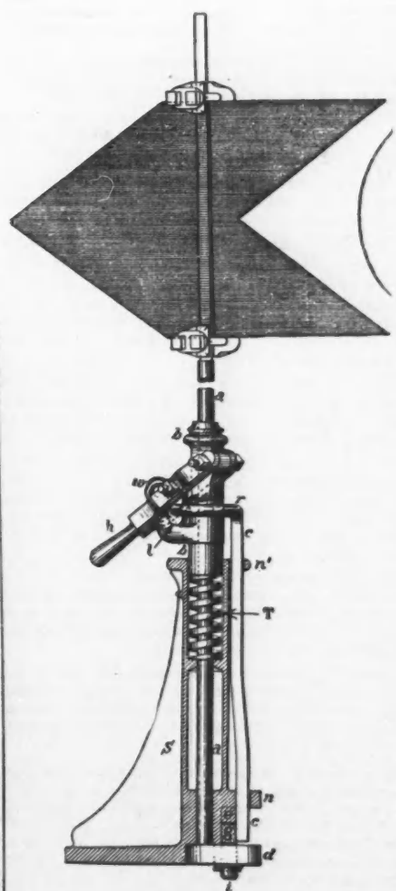

FIG. 90.—TRACY SWITCH.

(TO BE CONTINUED.)

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LITERATURE.

"*Water-Waste Prevention: its Importance and the Evils due to its Neglect. With an Account of the Methods adopted in various cities in Great Britain and the United States.*" By HENRY C. MEYER. Editor of the *Sanitary Engineer*. With an Appendix. New York, *Sanitary Engineer*, Publisher, 1885.

The above handsomely printed volume is a most seasonable contribution to hydraulic and ecomomic literature. Its author has personally and carefully investigated the problem from a practical standpoint in both England and America, and speaks with authority and backs his statements by official figures.

Water-waste is a crying evil in every large city in this country, and strenuous efforts are being made, or at least, much talked off, to abate it. But the editor of the *Sanitary Engineer* strikes at the root of the subject, in our mind, when he calls special attention to a powerful factor of waste, that is now too little heeded. We refer to the household fittings, the plumbing. The author enters into the detail of the inspection of fittings as practiced abroad, and shows how bungling, unscientific and dangerous work is there prevented by intelligent and careful official supervision and the official stamping of all tested fittings.

In our own country, and in the poorer classes of houses especially, where the tenants are least able or willing to see that work is done properly, these fittings are usually left to shape themselves after the sweet will of an ignorant plumber's apprentice; and the result is what might be expected—disease or death to the party directly effected and increased taxation for water wasted to the community in general.

The work treats generally of the condition of the water-supply of New York, and the methods tested or adopted for the prevention of waste in Glasgow, Manchester and Liverpool, and in our own cities of Providence, Cincinnati, Boston and New York. The data is derived from the most authoritative sources and presented in a shape that must carry conviction with it.

WATER.

MASON City, Iowa, has contracted for water-works.

HAYWARD, near Eau Claire, Wis., is to have a system of water-works.

AN analysis of the artesian well water of Savannah, Ga., shows it to be remarkably free from foreign matter.

LYNN, Mass., is discussing the advisibility of supplying Swampscott and Nahant with water as petitioned for.

THE question of establishing water-works at Beaver Dam, Wisconsin, will shortly be voted on.

THE Fond du Lac, Wis., council have decided that the city shall put in the Holly system of water-works.

A. L. JONES, of Philadelphia, was awarded the contract for the construction of water works at Harrisburg on May 16th, the only bid received being $25,000.

WASHINGTON, N. C., is exercised over the pollution of its water supply at Great Falls, by leakage from the filthy waters of the Chesapeake and Ohio Canal.

THE Columbus, Nebraska, Water-Works and Gas-light company has been incorporated. The company proposes to illuminate and liquidate at an early day.

THE Water Committee of the Councils of Lancaster, Pa., has decided to advertise for new boilers at the water works.

THE committee on water supply reported to the Senate a bill authorizing the town of Beverly, Mass., to lay a new water main, and secure a supply of water for domestic and fire purposes.

IT is a peculiarity of the Red River Valley that often pure water is found at a depth of a few feet and a few rods away at the same depth the water will contain so much alkali that it cannot be used.—*St. Louis (Minn.) Globe.*

SAN Francisco City Hall is furnished with water from a reservoir placed on the roof. Recently several very large and many small fish were discovered in the tank, although it is shown that none were ever put in there by any person.

THE new city council of Mt. Pleasant, Iowa, has, by its refusal to accept the water-works as constructed by the builders, succeeded in plunging the town in a litigation that promises to be more expensive than the original cost of the water-works system.

THE city council of Milledgeville, Ga., has about decided to have an artesian well dug at some suitable point in the city. At their last meeting one of the board was authorized to make inquiry and negotiate for the job.

THE water-works company of Council Bluffs, Ia., has changed hands, not in the immediate local management, as yet, Harry Birkinbine being still the engineer in charge but in the ownership. The new president of the company is Robert Sewell, of New York, and the new treasurer is Henry Allen, of the New York banking house of Allen & Stead.

THE city treasurer of St. Paul, Minn., paid water board notes due to the amount of $56,936.10 May 11th. There are $70,000 worth of notes still due, which will be paid in full at once.

The new 3,600,000 gallon pump at the water-works pumping station at St. Paul was started May 11th. This makes the average daily pumping capacity of the station over 5,000,000 gallons.

TAMPA, FLA., May 16th.—An election was held here to-day by citizens of Tampa, for the adoption of the Holly system of water-works. The proposition was unanimously carried.

FOLLOWING is a recent analysis of the water of the Dead Sea. Total residue, 15,260.0 grains per gallon; calcium carbonate 70.000; calsium sulphate, 163.39; magnesium nitrate 175.01; potassium chloride, 1,089.06; sodium chloride, 5,106.00; calcium chloride, 594.46; magnesium chloride, 7,388.21; magnesium bromide, 345.80; iron and aluminum oxides 10.50; organic matter, water of crystallization and loss, 317.57.

ACCORDING to the *St. Paul & Minneapolis Pioneer Press*. The cost of pumping, in Minneapolis, one million of gallons of water 140 feet high was, for the last year, $5.57; this does not include interest on cost of works and value of the water power. The largest amount of water pumped on any day was on the 20th of August, 10,936,700 gallons. The smallest was on the 6th of April, 1784, 4,815,360.

THE Yonkers Water Commissioners May 12th, made a tour of inspection of the springs, which, through the Grassy Sprain River, furnish the water supply of Yonkers. The visit had for its object the commencement of an action to restrain the Hollywood Cemetery Association from occupying the property they have selected for burial purposes, on the ground that it would endanger the health of the city by polluting the water.

MR. J. BAILEY DENTON has predicted that the year 1885 will be remarkable for a sort of water dearth in the east and south of England. He shows that the rainfall in 1884 was not more than two-thirds that of the average, while the proportion of rain evaporated was unusually great, and he therefore maintains that this year there must be a lowering of the subterranean water supply, and a reduction of the yield of the springs which supply the rivers, entailing an increase of the evils of the pollution of the streams.

EAU CLAIRE, WIS., May 12th.—Fifty men who were laying pipes for the water-works this morning were overpowered by a crowd of 200 laborers and forced to quit work. The crowd marched to the Pioneer and also to the Sherman Saw Mills and forced them to shut down. Some violence was used. All the other saw mills shut down before the strikers arrived except the Eau Claire Lumber Company, whose mills are still running. The demand of the water-works strikers is for $1.50 per day. The saw mill employes made no demands, but were forced by the strikers to suspend work.—*Exchange.*

THE Virginia (Nev.) *Enterprise* says: "It will be remembered that some months ago, in boring the artesian well at White Plains, out in the eastern part of this State, under the auspices of the Central Pacific Railroad Company, a large log, or several logs of wood were bored through at the depth of 1,615 feet below the surface. This has been a subject for discussion by scientists ever since, and a few evenings ago, in San Francisco, Dr. Harkness made it the special subject of a very interesting lecture. Quite a large quantity of this wood was brought to the surface, and it was good sound wood, in an almost perfect state of preservation although its great depth and the character of the superincumbent strata showed that it was at least 1,000,000 years old. Microscopic examination shows that the ancient tree was similar to the present nutpine.

THE late report of Superintendent Henion of the Minneapolis water-works gives the following figures:

Total cost of works to date	$893,474.56
Running expenses for year	41,864.22
Collections of water rents	83,115.24
Increase over last year	15,053.42
Number new hydrants set	144
Total number of hydrants in city	485
Number new gates	65
Total number of gates	248
Number feet pipe laid during year	53,184
Cost of same	137,483.32
Number miles mains in city	41
Number gallons water pumped	2,589,037,618
Number new taps made	513
Total number taps	3,050

AT the annual meeting May 12th, of the Stillwater, Minn., Water company Hon. E. W. Durant was re-elected president; Col. R. F. Hersey, vice president; Matt Clark, secretary and treasurer, and H. H. Harrison, superintendent and engineer. This company was organized in March, 1880, and has never yet declared a dividend, having applied all its surplus earnings upon improvements. They have now eight and one-half miles of water mains, eighty-eight hydrants and about 260 taps. The water supply is obtained from Lake McKusick, which is supplied from Brown's creek. The lake is 155 feet above the business portion of the city, and is about one mile distant from the same. The water is pumped into a reservoir on the highest spot of ground in the city, which is 110 feet above the lake, and 265 feet above the business portion. The system is similar to that of St. Paul, the city being supplied in part by gravitation, and in part by direct pressure. The elevation of the reservoir results in a saving to the city in the matter of fire engines, etc. Any fire in the business part of the city can be extinguished with the use of hose alone. One fire engine answers the purposes of the city.

THE new water-works of Naples, Italy, were formerly opened on May 11th. King Humbert and his Queen assisted.

A NEW scheme for supplying the dry goods district of New York City with water in case of fire has been presented to the Sinking Fund Commissioners by Mr. Edward Patterson, on behalf of the New York City Water Company, which claims to have a capital of $1,500,000, "either guaranteed or paid up." The proposition is to draw the requisite water from wells to be constructed within the dry goods district, and to keep a reservoir constantly filled with $10,000,000 gallons of water ready for use within an area of ten miles, and under a pressure capable of throwing a stream 150 feet high, or to the top of the tallest building in the city. The water company asks the city to guarantee $150,000 a year for the use of the water for the purpose of extinguishing fires, and does not ask the payment of one dollar until the water is ready for use. The Recorder and City Chamberlain will examine the plan and report to the Commissioners.

NEWS OF THE WEEK.

Miscellaneous.

Germany has 324 and France 325 locomotives for every 1000 kilometers of railway.

A cord of seasoned wood weighs, say, 4000 pounds. This cord of wood, placed in a charring receptacle and subjected to a proper temperature for, say five days, entirely disappears. In its place we have 1000 pounds of charcoal, 2000 pounds of pyroligneous acid, and 1000 pounds of uncondensed gases. The aggregate weight of these products is equal exactly to the original weight of the wood.

Profitable Canal Shares.—M. de Lesseps relates that on the occasion of his marriage, the day of the Suez Canal, November, 1869, his father-in-law handed him 100,000 francs as a present to his wife. At that time, he adds, Suez Canal shares were selling at 250 francs, or 50 per cent discount. He invested the present in these shares, on which he realized 1,500,000 francs.

A New Balloon.—A German engineer is said to have made an important improvement in aeronautics by which he is enabled at will to expand or condense the gas in a balloon. The gas he prefers is compressed carbonic acid, and he so employs it that he is able to make the balloon ascend or descend at pleasure, and hopes thus to direct the course in any desired direction by placing the balloon under the influence of a favorable current wherever it may be situated in the atmosphere.

Only Practical Surveyors.—A new rule has been established in the Interior Department, limiting appointments to the office of Surveyor General of the Territories to practical surveyors. At the present time the majority of these offices are in the hands of men who are dependent upon their chief clerks or deputies for their technical information as to the letting of contracts for surveys and the correctness of accounts for work done.

Iron Minerals in France.—The quantity of iron minerals imported into France in the first eleven months of last year was, 1,261,654 tons, as compared with 1,451,841 tons in the corresponding period of 1883, and 1,264,703 tons in the corresponding period of 1882. The total of 1,261,654 tons was made up as follows: Belgium, 174,772 tons; Germany, 438,308 tons; Spain, 410,009 tons; Italy, 42,449 tons; Algeria, 181,612 tons; and other countries 14,504 tons.

The Thermic Motor.—For the past few months the Triple Thermic Motor Company has had under construction in Lowell, Mass., an engine, which it was proposed to be devoted to the use of the Middlesex Electric Light Company of Lowell. The engine was started at the works in Jackson street on May, 6. The motive power to be used is bisulphide of carbon; it is vaporized by steam, and not by immediate contact with the fire. The boiler and pipes which convey the vapor are encased in other boilers and pipes containing steam; as this agent attacks all oils, the only lubricant used is pulverized plumbago, which is suspended in a liquid composition known only to the inventor. The machine at the works in Jackson street consists of two twenty-four power steam boilers, two large bisulphide boilers of a capacity of 60,000 pounds each of the liquid, and an engine manufactured at Fitchburg of 170 horse-power. Early yesterday a wood fire was built under one of the steam boilers and when the engine started the steam gauge indicated a pressure of twenty pounds and the bisulphide gauge sixty pounds. The surface pressure was two pounds. The engine started at slow speed, and was kept at a uniform rate for a short time, when a valve was turned and nearly the highest rate was given. It was slackened when required, and the machine seemed under perfect control. It is probable that all the dynamos of the Middlesex Electric Light Company will be transferred to the building at an early date.—*Boston Gobe.*

Density of American Woods.—Of the 413 species of trees found in the United States, there are sixteen species whose perfectly dry wood will sink in water. The heaviest of these is the black ironwood (Condalia ferrea), of Southern Florida, which is more than 30 per cent. heavier than water. Of the others, the best known are the ligum vitæ (Guaiacum Sanctum) and mangrove (Rhizophora Mangle). Another is a small oak (Quercus grisea), found in the mountains of Western Texas, Southern New Mexico and Arizona, and Westward to the Colorado desert, at an elevation of 5000 to 10000 feet. All the species in which the wood is heavier than water belong to sem -tropical Florida or the arid interior Pacific region.

What an Eighty-ton Gun Cost.—In the House of Commons last night Mr. Brand said: "One of the guns of her Majesty's ship Inflexible is unserviceable in its present condition, but it is repairable. It is a muzzle loader. It has a steel tube, with outer coils of wrought-iron. It has an enlarged powder chamber. It was manufactured at the Royal Gun Factories. Its cost was £10,075. It was first fired after being mounted in position on board ship, I believe, in 1880. It has fired eighty-six rounds up to date. It is proposed to replace this gun by the reserse (on loan to Shoeburyness for an experiment against armor plates). The reserve gun is of the same design. There are six of these guns in use—four in the Inflexible, two in Dover Turret—and beyond this there are two reserve guns. To reline the damaged gun will not cost more than £400."—*London Times.*

The Afghan Matchlock, or jazil has no parallel as a fire arm on the face of the earth. It is about nine feet long, and is fitted near the muzzle with a prong which supports it on the ground when it is about to be fired off. It is fitted with a powder pan and a catch for holding a fuze. An Afghan marksman has to depend upon the state of his fuse, and, therefore, he is by no means a certain shot. During the last Afghan war it used to be a joke among the British soldiers that an Afghan would poise his jazil upon a rock, calculate when his enemy would be likely to arrive in front of his muzzle, fix his fuze and then go off to some little distance and sit down and smoke. If the enemy arrived in front of the matchlock just as it went off, why then he would most likely be killed, but if he didn't and the weapon went off a quarter of an hour after he had passed it, then no harm was done and the owner would philosophically "set" the jazil again in the hope of catching the next comer, and then go on to his rock, smoke and await developements.

Contracting.

Five New Dredges are to be built for the Atlantic Coast canal, and the work for connecting the Halifax with the Mantanzas must be completed by Nov. 1st.

Not so much Cement. The order of New York parties for 2,500,000 (?) barrels of cement as stated in several western papers as being placed with the Standard Cement Works of Mankota Minn., has been reduced to 2 500 barrels by later advices.

New Cars for West Shore.—Twenty-five new passenger coaches have been received from the Pullman car works for regular service on the New York, West Shore & Buffalo Railway. These cars are equal in every respect to the high standard originally adopted by the West Shore Company.

Cape Fear (N. C.) River Bridge Masonry.—F. Gardner, Engineer of the W. & F. R. R. advertises for proposals for building 1,600 cu. yds., of coursed masonry for the bridge over the Cape Fear River, near Fayetteville, N. C., and also for another bridge of random rubble work over the Neuse River. Bids received until June 10.

Prospective Work for Contractors.—ALBANY, N. Y.—The following among other bills now await the signature of Governor Hill:

Amending act incorporating the New York and Long Island Bridge Company—Senator Otis.

Authorizing the Metropolitan Transit Company to discontinue its main line north of One Hundred and Twenty-fifth street, and to change the location of the bridge across the Harlem River—Senator Plunkitt.

Authorizing the construction of a public bridge over the Harlem River—Senator Plunkett.

The Underground Wire bill, providing for placing electrical conductors underground in cities of this State, and for Commissioners of Electrical Subways—Senator Daly.

Arcade Railroad bill—Senator Thomas.

Authorizing the fund now paid into the City Treasury by the elevated railroad companies to be applied to the erection of a model of an elevated railroad (the Harvey scheme)—Introduced by Senate Railroad Committee.

Among the bills relating to Brooklyn and Kings County now before the Governor are these:

Extending charter of Brooklyn Elevated Silent Safety Railway—Assemblyman Coffey.

Relating to the use of steam upon Atlantic avenue.

Providing for the completion, control and management of the New York and Brooklyn bridge—Senator Daggett.

Improvement of Neuse River, N. C.—Capt. W. H. Bixby, U. S. Eng'rs., forwards the following abstract of proposals for above work: There were four bids. The work to be done included 160,000 feet B. M., best heart pine, bid at $14 and $15 per thousand; 750 lbs. iron at 4 cents per lb.; 20 kegs nails, at $3 and $3.79 per keg.

Cincinnati Street Paving.—City Engineer Danenhower, of Cincinnati, has concluded to give the artificial corrugated iron-slag paving blocks a trial. In regard to dimensions of paving blocks generally the engineer recommends that they be from 8 to 12 inches in length, not more than 4¼ inches nor less than 3 inches wide, and not more than 7 inches nor less than 6 inches deep.

North Minneapolis Sewer Tunnel.—The committee on sewers met with City Engineer Rinker, May 11th, and considered matters pertaining to the North Minneapolis sewer tunnel. The contract price for the tunnel complete was $16.97 per lineal foot, and of this amount the city has held back about $4 per foot for the first four sections, and also $1 per foot for certain brick work at a point now reached. This $1 the contractors ask shall be given them, and the committee has agreed to do so. The members of the committee, accompanied by the engineer, made a personal inspection of the work on the tunnel, and they report that the work is being done very satisfactorily. The entire length of the tunnel will be 6,000 feet, and about 1,300 feet have already been completed.

The 14-Foot Bank Lighthouse.—Anderson & Barr, contractors for the foundation of the above lighthouse in Delaware Bay, will start work this week. They propose to build on shore a wooden caisson 36 feet square, with walls 3 feet thick, all of yellow-pine, 12 × 12 inches; the roof will be 5 feet thick. On top of this caisson will be a cast-iron cylinder 35 feet in diameter, and shell 2 inches thick, and 73 feet high, put together with inside flanges. The air-lock and its shaft, 5 feet in diameter, will occupy the center of the main cylinder. When completed the caisson will be filled with sand and the cylinder with concrete to H. W. mark; on top of the iron cylinder will be the lighthouse. The present depth of water at low tide over the shoal is 20 feet, the caisson will be sunk 53 feet below L. W.

Bids for Bridge at Minneapolis, Minn.—May 12th the council committee on roads and bridges, and the city engineer met at the office of the latter in the city hall, for the purpose of opening bids for completing the piers and substructure of the new bridge across the Mississippi at the foot of Washington avenue south. Seven proposals were received, which included figures for different classes of stone to be used, and specifically designated as follows: Class A, Minneapolis limestone; class B, Red Wing stone; Class C, Mankato stone; class D, Iowa stone, and Class E, granite. The several bids are given below:

	Per cubic yard.
McArthur Brothers, Minneapolis—	
Masonry, Class A	$12.00
Masonry, Classes B, C and D	17.00
Masonry, Class E	40.00
Concrete masonry	6.00
Excavating for piers 1, 2 and 3	.50
Excavating for piers 4 and 5	2.00
James Baxter—	
Class A	11.50
Class B	16.50
Class C	16.30
Class D	17.00
Class E	29.00
Excavation for piers 1, 2 and 3	1.25
Excavation for piers 4 and 5	2.00
Concrete piers 4 and 5	4.75

L. B. Bruce bid for the completion of the entire substructure, $49,995, including three new piers, using Mankato stone throughout, excepting the portions where granite is called for in the advertisement and specifications. In case of an increase above the approximate estimate, an addition of $10.50 per cubic yard is called for with deductions to an equal amount in case the amount of work falls short of the estimate.

	Per cubic yard.
W. F. Van Voris, class A	$11.00
W. F. Van Voris, class B	13.50
W. F. Van Voris, class C	36.00
Concrete for piers 4 and 5	3.50
Excavation for piers 4 and 5	3.00
Excavation for piers 1, 2 and 3	1.00

R. M. Riner, for work complete and in accordance with the specifications, $66,700 for the substructure.

	Per cubic yard.
Martin, Ring & Co., class A	$12.00
Martin, Ring & Co., class C	16.00
Martin, Ring & Co., class E	35.00
Excavation piers 1, 2 and 3	1.50
Excavation piers 4 and 5	6.00
Concrete masonry	5.00

To use Mankato stone, except where granite is specified.

So far as could be determined, without a careful mathematical calculation, the bid of L. B. Bruce, $49,995 is the lowest, and R. M. Riner's bid of $66,700 is the highest, and such will probably be the report of the engineer at the adjourned meeting of the council this evening. The contract for the iron superstructure has been awarded to the Canton Bridge company at $54,000, and, in case Mr. Bruce's bid is found to be the lowest after examination, the total cost of the new bridge will be $103,995.—*Pioneer Press.*

Cincinnati Sewer Bids.—The Engineers of Cincinnati, O., submitted May 12th, the following computation of bids for sewers in part of District Two, Division Seven (Race, Elm, Findlay, McMicken avenue, etc.) H. Frank, $14,639.75; Thomas Peters and John Scully, $13,867.05; Volz & Ashman, $13,394.10; Wm. Scully and Mr. Peters, $16,262; B. D. Barton and Thomas M. Steele, $15,310.50. The bid of B. Barton was thrown out as informal. The contract was awarded to Folz & Ashman, and a resolution transmitted to Council.

The Philadelphia Intercepting Sewer.—The number of feet of rock to be tunneled is 804, and with the exception of this short distance, the sewer is completed from its outlet at the Callowhill street bridge to a point 12,563 feet up the bank of the river. The total length of the sewer will be nearly 7¾ miles. From the outlet to the Falls of the Schuylkill the distance is 19,000 feet; from this point to the Wissahickon it is 5,000 feet, thence to the canal locks in Manayunk, 5,000 feet, and thence to the American Wood Pulp Company's wharf, 6,000 feet.

The estimated cost of the work is $600,000, and the rapidity of the construction will depend entirely upon the liberality of Councils. $325,000 will be required to complete the sewer as far as the Wissahickon. Nearly $200,000 has been expended so far, and this year's contracts will cost in the neighborhood of $100,000. The lateral connections which will have to be made along the line will sum up the total cost to a larger figure than the estimate, but this expense does not properly apply to the actual cost of constructing the sewer.

This large drain is four feet six inches in diameter, and will have a fall of 215 feet to the mile. The walls are of brick lined with cement and can be flushed with water from the Wissahickon or from the canal should it be necessary to do so, which is very doubtful, considering the incline.

The sewer is designed to protect the water of the Schuylkill from sewage, and the name given to it is because it intercepts all sewers now emptying into the river.—Phila. *Evening Bulletin.*

Railroads, Bridges and Canals.

The Central Pacific Railway will hereafter burn petroleum instead of coal in its Sacramento and other large shops.

The New York Arcade Railway passed the N. Y. Legislature on May 15th, and awaits the approval of the Governor.

Hand Grenades are now carried in passenger coaches of the Bee-line, as well as axes, water-buckets, etc., to use in case of an accident or a coach taking fire.

The New Haven & Northampton Railroad Company is building a new iron bridge over the Farmington river. It is 389 feet long, and will cost from $18,000 to $20,000.

The Burlington & Missouri River Railroad company has let the contract for its new extension of seventy miles into Kansas City. The branch is to run from Republican City to Oberlin.

The Mexican National R. R.—W. Morcom, General Passenger and Freight Agent of the Mexican National, Southern Division, is in the city. Mr. Morcom says that during the past three months, which constitute the best season for trade, the road has done a better business than ever before. He is very confident that the connecting line between the Northern and Southern Divisions will be started in a short time and when once begun it will be easily completed, as it runs through a very level country. Concerning the coal mine discovered on the line of the Mexican Central at Jimulco, Mr. Morcom says that he understands that the owner of the property demands $50,000 for it, and a royalty of $5 a ton on the output forever after. Mr Morcom is stopping in the city for a few days, and will go West.

The New Cambridge Bridge.—Alderman Curtis, of the Boston, Mass., Councils, submitted a report from the committee on New Cambridge bridge, recommending that the proposed bridge across Charles river, between West Chester park and Front street, extended, be built. The following orders accompanied the report:

That the joint special committee on Cambridge bridge be authorized to contract for building an iron bridge across Charles river to Cambridge, in accordance with plans and specifications prepared by the city engineer; the cost of building such bridge not to exceed $450,000, and to be borne equally by the cities of Boston and Cambridge.

That the city treasurer be authorized to borrow, under the direction of the committee on finance, the sum of $225,000, at such rate of interest, and for such length of time as said committee may determine; the same to constitute a special appropriation for building a new bridge to Cambridge.

The plan contemplates an iron bridge, with stone abutments, the bridge to be seventy feet wide, with a draw opening of thirty six feet. The report was accepted and the order providing for a loan was referred to the committee on finance.

The Blackwell's Island Bridge Bill passed the New York Assembly May 14th.

The Soudan Railway.—The 1,200 coolies from Bombay, who arrived at Suakin in the "Jumna," and, after disembarking, were again sent on board and ordered back to Bombay, have been stopped at Aden, and are now on their way back to Suakin.

A Proposed R. R. From Dallas Texas.—A special from Dallas, Texas, says: The merchants of Dallas have subscribed $1,000 a mile for 150 miles of railroad, to run northwest from Dallas to the coal-fields and rich agricultural land in Wise County. The capital stock is put at $2,500,000.

R. R. Bridges to be Tested.—The N. Y. Commissioners of Railroads propose to examine and test through competent engineers each of the 3,500 wood or iron railroad bridges in the State. New York is the first State to adopt this plan suggested in 1875 by the Am. Soc. of Civil Engineers.

In Order To Reach Northwest India, it is proposed to construct a Trans-Arabian railway from Port Said to Kowiett Harbor, on the Persian Gulf, a distance of 1,030 miles. The estimated cost is $60,000 per mile It is deemed an important undertaking as a checkmate to the Central Asian Railway scheme now being pushed by Russia.

The Tehauntepec Ship Railway.—E. L. Corthell, Chief Engineer of the Ship Railway Co., lately addressed the Society of Arts, in Boston, on the possibilities and prospects of the Tehuantepec Ship Railway. He was enthusiastically received by his audience.

The Penna. vs. the B. & O. R. R. in Philadelphia.—The Penna. R. R. is using every effort to make the work of the B. & O. R. R's entrance into Philadelphia more costly. The first named company is working day and night to raise its tracks intersected by the B. & O. four feet, required the new company to at least do the same.

A Railroad Museum.—The N. Y. Central Hudson River R. R. Co., have established a small museum of material connected with railroading, in the basement of the Grand Central Station. Among the relics are the old driving wheels of the De Witt Clinton, an engine built in 1831; the wheels are 5 feet in diameter and weigh 350 lbs., each with solid hub and spokes 1 inch in diameter.

The Aransas Pass.—SAN ANTONIO, TEX., May 15th.—Work on the Aransas Pass Railroad from this place, President Lott says, will commence on Monday afternoon, when the first spade will be driven and the firs dirt turned on a direct route to the Gulf from this point. A very large grading outfit has now encamped near the point of commencement.

Electricity Substituted for the Bell-Rope.—H. E. Judkins, a conductor on the Maine Central R. R. has invented an electric train signal. An open circuit battery is located on the engine and connected by an insulated wire with each car; push-knots in the cars convey the signal to the engineer. The invention has been in use for some months on the Maine Central & Boston & Maine and has given much satisfaction.

Cape of Good Hope Railway System.—The eastern system of the Cape of Good Hope railways, passing through the colonial coal fields, was completed and opened for traffic to Burghersdorp on March 19. The coal is of a very inferior quality, having about 33 per cent of ash, but as it can be mined very cheaply it will probably be extensively used instead of imported coal which costs from $9 per ton at Cape Town to $60 per ton in the diamond mines in the extreme interior of the colony. Special arrangements of fire-boxes and grate-bars are necessary for burning this coal on locomotives

The Henderson Bridge, Ky.—The entire forces at work on the new Henderson Bridge of the Louisville and Nashville Railroad have been concentrated on the middle or channel span, which is to be 556 feet long. The work, unless high water should interfere, will be completed by the 15th of June.

The Keystone Bridge Company give notice that false work will be placed across the channel span of the Ohio Bridge at Henderson, Ky., now in course of construction. This span will be closed to navigation from May 1 to about July 1.

Chicago, St Louis and Nashville Railway Company was incorporated at Springfield, Illinois, on May 13th, to build a road from East St. Louis through the Counties of St. Claire, Monroe, Randolph, Jackson, Williamson, Union, Johnson and Massac, in Illinois, to the Ohio River opposite McCracken County, Kentucky, the principal offices to be in East St Louis, capital stock $6,000,000. The incorporators and first Board of Directors are: H. Clay Conde, St. Louis; C. A. M. Schlierholz, of Waterloo, Ill.; Wm. O. Towle, of Waterloo, Ill.; William A. Lemma, of Carbondale; Albert L. Blackman, of New York; John S. Crum, of Vienna, Ill., and Richard L. Miller, of St. Louis. The continuation of the proposed road is to form a direct line between St. Louis, and Nashville, Tenn.

Railroads in Mexico.—The Mexican Central has 1,239 miles of completed road, and the Sonora, another Boston enterprise, will have when completed, about 300 miles. The Mexican National, chiefly a New York company, is operating about 800 miles in Mexico, at least if its own reports can be trusted, as they are not by some The Mexican, Oriental, Interoceanic and International will soon have 600 miles. The Sinaloa and Durango is operating 39 miles. The five lines now in operation are represented by stock and bonds aggregating about $200,000,000, besides the Mexican Railway, owned in England, which has a total stock and bond capital of about $45,000,000.—*Boston Advertiser.*

From the Black Sea to the Caspian.—Russia is about to begin a second railroad between the Black Sea and the Caspian, along the foot of the Caucasus on the North, while the existing railroad is South of the mountains. Like the other Russian railroads, it will be of five-foot gauge. The cost, with harbor improvements at Novorissik, is estimated at $9,500,000, or $55,000 per mile. The line will give an outlet to a productive grain country as well as to petroleum. The latter does not depend upon it wholly, as there is now a pipe line sixty miles long leading from the wells to Novorissik. When built it will be possible to ride by rail all the way from the Atlantic to the Caspian Sea.

Index to Periodical Literature.

Steam, High Pressure.—*Economy in the Use of High Pressure Steam.* The advantages of the use of high-pressure steam are stated in detail, accompanied by tables. An improved horizontal fuel boiler for high pressure steam is described and illustrated, and its advantages considered. By Wm. Barnet Le Van, with discussion. *Jour. Frank. Inst.* May, 1885, pp. 396 to 407.

Telpherage. A detailed description of the method of transportation by the aid of electricity, designed by the writer, by which vehicles are sent along a single suspended rod or wire. The motors are described very fully with illustrations of various kinds. An estimate of the cost of construction and operation is given. By Prof. Fleeming Jenkin. (From the "Journal of the Society of Arts.") *Van Nostrands,* May, 1885, pp. 353 to 364.

Railroad Station.—*Nouvelle Gare de Berlin, du chemin de Fer de Berlin Anhalt.* A detailed description of the passenger and freight stations as recently reconstructed, which are considered to be well planned both as a whole and in their details. A detail sketch of the iron and roof of the passenger station, with a span of 62.5 meters (over 200 feet) is given. Illustrated with general views, plans details, etc. *Revue Générale des chemins de Fer.* Feb, 1885, pp. 98 to 106.

Rivets.—*The Selection of Loose Rivets.*—Some brief general statements of the places where and circumstances under which the rivets in riveted work are apt to be loose. Rules for their detection. Abstract from a paper before the Engineering Soc. of Mich. by Jas. Sanderson. *R. R. Gazette,* May 1, 1885, pp. 273 and 274.

Market Report of Engineering Materials.

New York, May 21, 1885.

NOTE.—The following Market Report gives wholesale prices on the New York Market unless otherwise stated. It is intended as a general guide to the estimating engineer, and both the range of material and the market location will be extended as rapidly as possible. We give it with this caution, that, as is well understood in business transactions, the amount of bill, distance from market centre and conditions of payment will have a material influence on the final paying prices.

IRON.

STRUCTURAL IRON.		
Angles	1.9c. @	2.2c.
Tee	2.2 @	2.25c.
Beams and channels	3.0c. @	
Tank	2.1c. @	2.15c.
Shell	2½c. @	2¾c
Steel plates, Tank	2¾c. @	3c.
WROUGHT-IRON PIPE. PITTSBURGH.		
Butt welded, black.....Discount	50	
" galvanized..... "	40	
Lap welded black..... "	67½	
" Galvanized..... "	50	
Boiler tubes	60	
RAILS.		
Steel (large lots at mill)	$26.50 @	27.00
Old rails	16.50 @	17.00
Oldrails, steel	17.00 @	17.50
R. R. spikes	1.8 @	1.9c
R. R. splice-plates	1.65c. @	1.75c.
R. R. Track Bolts	2.6c. @	3c.
Barb-wire fencing, galvanized	4¾c. @	5½c.
" painted	3¾c. @	4½c.
or rugated iron		
ails		
Iron	2.25	
Steel	2.25	

METALS.

COPPER.		
Lake Superior	11½ @	
Other Brands	10¾ @	11½
LEAD.		
Com. Domestic	3.65 @	3.70
Lead Pipe	.06¾	
Tin-Lined Lead Pipe	.15	
Sheet Lead	.06¾	
ZINC.		
Sheet	0.05 @	0.05½

BRICK.

(Cargoes afloat)		
Haverstraw 1st.....per M.	$5.75 @	6.25
" 2nd..... "	5.62 @	5.87
Fishkill	4.75 @	5.50
Up-River		
Jerseys	5.25 @	
Long Island		
" pale		
FRONTS.		
Croton red	14.00 @	
" dark	14.00 @	
" brown	12.00 @	
Philadelphia pressed	22.50 @	23.00
Trenton "	22.50 @	23.00
Baltimore "	37.00 @	41.00
Buff "	33.00 @	35.00
Enameled English	65.00 @	130.00
" American	85.00 @	120.00
Fire brick	25.00 @	40.00

CEMENT.

PORTLAND.		
Gibb's English 400 lbs. per bbl	2.75 @	2.90
K. B. & S. " "	2.85 @	3.00
Burham " "	2.70 @	2.85
Keene's fine " "	9.50 @	9.75
" course " "	5.25 @	5.75
Roman	2.75 @	3.50
Largerdorfer German "	2.55 @	2.80
Dyckerhoff, "	2.90 @	3.25
Stettiner " "	2.60 @	2.65
Vorwohler, Lion "	2.90 @	3.25
Alsen, " "	2.55 @	2.60
Fieve " "	2.40 @	2.50
Saylor's American	2.15 @	2.40
Windsor }	1.00 @	1.10
Standard } U. S. C. Co.	1.35 @	1.50
Cable's Portland }	2.15 @	2.40
ROSENDALE cements	1.00 @	1.10

LIME.

Rockland common per bbl	1.00	
" finishing	1.20	
Glensfalls, common	.85	
" finishing	1.05 @	1.10
Kingston, ground	0.95	

STONE.

Cargo rates at New York.

Amherst freestone, No. 1 per cub. ft.	0.90 @	95
" " No. 2 "	0.75 @	0.80
" " light drab "	0.80 @	0.95
Berlin " in rough "	0.75 @	1.00
Berea " " "	0.75 @	1.00
Brownstone, Portland, Ct. "	1.00 @	1.30
" Belleville, N. J. "	0.75 @	1.25
Granite, rough	0.60 @	1.25
Common building stone per load	2.00 @	3.00
Base stone, from 2½ to 6 ft. lengths, per lin. ft.	0.40 @	3.00

SLATE.

Purple roofing per square	6.00 @	7.00
Green "	6.00 @	7.00
Red "	15.00	
Black Penna. (at New York) "	4.50 @	5.00

LUMBER.

PINE, Common box per M.	18.00 @	20.00
" Good "		
Tally plank, 1¼ in each.	.44 @	.50
Tally boards, dressed com. "	.28 @	.30
SPRUCE, Boards dressed "	.25 @	.28
Plank, 1¼ in "	.28 @	.30
" 2 in. "	.38 @	.40
" 2 in. dressed "	.43 @	.45
Timber per M.	20.00 @	22.00
HEMLOCK, Boards each.	.18 @	.20
Joist, 2½ × 4 to 4 × in	.17 @	.44
OAK per M.	55.00 @	65.00
CYPRESS 1, 1¼, 2 and 2½ in "	35.00 @	40.00
YELLOW PINE, Girders "	26.00 @	35.00
Dressed flooring "	30.00 @	40.00
SHINGLES, Extra shaved pine, 16in. "		
" sawed 18 in. "	4.50 @	5.00
LATH, Cargo rate "	2.40 @	2.50

PAINT.

Lead, white, American dry per lb	.04¾ @	.05
" " in oil pure "	.05½ @	.05¾
English, B. B. in oil	.08½ @	.08¾
Red, American	.05½ @	.05¾
Litharge "	.05 @	.05¼
Venetian red, American "	.01 @	.01¼
Indian red "	.05 @	.10
Vermillion, American lead "	.11 @	.11¼
Paris green "	.15 @	.19
Umber, Amer. raw and powdered per lb.	.01¼ @	.01¾
Drop black, Amer.	.08 @	.12
" "	.09 @	.11¼
Chrome green	.05 @	.15
Oxide zinc, American	.03¾ @	.04
" French	.06¾ @	.06¾

To Avoid Danger.—An Irishman was noticed to get off the train on the "Burlington Route," at every station, and some one finally asked him the reason.

"Be gorry, look there!" said he, pointing to the following:

"Notice to Passengers—To avoid danger from passing trains, passengers are directed to get off the cars on the right-hand side, facing toward the engine, at all stations where there is double track."